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ABSTRACT

Sixteen investigations using 32 third graders, 286 fourth graders, 183 fifth graders, and 343 sixth graders, were undertaken to determine table-using proficiencies. The data indicate that: (1) upper elementary students are able to retrieve information accurately and quickly from noncomplex numerical tables over a wide range of levels of tabular extensiveness; (2) performance falls off with increasing complication of the tabular display and conditions of performance; (3) a small investment in formal table-using instruction results in reasonably accurate performance even when tables and associated performance conditions are complex; and (4) uncritiqued table-using practice suffices to elevate the speed with which data are retrieved from tables. (MP)

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SWRL EDUCATIONAL RESEARCH AND DEVELOPMENT

SE 027 845

Table-Using Proficiencies of Upper Elementary Schoolers

TR 62 October 20, 1978

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SWRL EDUCATIONAL RESEARCH AND DEVELOPMENT

TECHNICAL REPORT 62

October 20, 1978

TABLE-USING PROFICIENCIES OF UPPER ELEMENTARY SCHOOLERS

Joseph F. Follettie

ABSTRACT

Sixteen investigations--using 32 3rd graders, 286 4th graders, 183 5th graders, and 343 6th graders--were undertaken to determine the table-using proficiencies of upper elementary schoolers. The data indicate that a) upper elementary schoolers are able to retrieve information accurately and quickly from noncomplex numerical tables over a wide range of levels of tabular extensiveness, b) performance falls off with increasing complication of the tabular display and conditions of performance, c) a small investment in formal table-using instruction results in reasonably accurate performance even when tables and associated performance conditions are complex, and d) uncritiqued table-using practice suffices to elevate the speed with which data are retrieved from tables. It is concluded that more extensive use of numerical tables is warranted than now occurs in published educational materials addressing upper elementary schoolers.

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TABLE-USING PROFICIENCIES OF UPPER ELEMENTARY SCHOOLERS[1]

Joseph F. Follettie

This is the first of two reports investigating the conditions under which upper elementary schoolers--4th-6th graders--effectively process information in tables and graphs. These display forms are seldom used in published educational materials addressing upper elementary schoolers outside a mathematics instructional context (Follettie, 1978f), perhaps because materials authors/developers suppose students cannot effectively use them.

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[1]Data collection was managed by Caroline Fieker and Gail Pratt. The data were collected by Sharian Burroughs, Barbara Moll, Martha Mondello, Alice Roop, and Katie Wei.

2. BACKGROUND

2.1 LITERATURE

Much educational research stems from a radical empirical orientation that is masked by an alleged theoretical issue and reference to a handful of allegedly comparable studies yielding conflicting results. From such work is formed a literature akin to bricks in a brick pile; the different studies typically do not cohere or cumulate. The numerical display literature has this character.

The pertinent literature is scant and sketchy. Reviewed elsewhere (Follettie, 1978a), few studies feature elementary school participants. Almost none investigate the effects of different levels and forms of portrayed numerical information on different categories of performance. Although occasionally revealing an interesting proposition or finding, the numerical display literature sheds little light on how specified displays should be designed or when used and under what conditions. Coherent research presupposes some sort of unifying structure--a quantitative model and/or one or more heuristics.[2]

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[2] A quantitative model reflects a field of parameters standing in specified mathematical relations, affording a basis for precise predictions or expectations in the model's domain. Maturing research eventually comes under the control of such a model. During the earlier history of given research, the pertinent parameters themselves remain conjectural; attempts to quantify relations holding between parameters therefore are idle at this point in the inquiry.

Early research can be controlled in certain respects using one or more heuristics. Some heuristics are quite elaborate--involving taxonomic distinctions, the specification of event sequences, the use of "rules of thumb" analyses, etc. Such devices apparently warrant the common supposition that a heuristic is incapable of proof. The heuristics of interest here are simply taxonomic--distinguishing for example between certain features of numerical displays that entertainably mark parameters

2.2 CLASSES OF VARIANCE SOURCES

The work to be reported stems from taxonomic distinctions marking factors that might account for tabular display effects. Presented in detail elsewhere (Follettie, 1978b), elements of these constructions are described below. They ground on intuition, rational analysis, and whatever entertainable advice the literature affords. Herein, they are said to give rise to a priori characterizations of displays and tasks. They mark potential sources of variance whose effects during empirical study determine whether they are useful sources.

This paper's programmatic research orientation assumes that inquiry enabling the rational selection-construction of information displays should jointly consider variance sources of four classes:

- The population(s) to which generalization of findings is intended.
- Surface and underlying information characteristics of studied displays.
- Those display-processing tasks apt to studied displays.
- Conditions underlying studied performance.

It is assumed that empirical work that jointly considers these four source classes will prove usefully exhaustive.

This multiple source class orientation is in the spirit of a developing orientation of educational researchers who are attracted to

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pertinent to accounting for the effects of such displays on specified performance. Some such factors form quantitative-enumerative progressions; others simply reflect categorical contrasts. The value of such conceptual-conjectural devices is that they force and enable an early overviewing of investment options in a given research domain. While no amount of evidence perhaps would warrant accepting a given set of taxonomic distinctions as "true," it does not require much research to establish whether these distinctions are tenable in light of state-of-the-art sophistication.

display research but repulsed by a largely ineffective traditional media research. Nuance variations overlooked, the perspective shares a general orientation with such works as Snow (1974), Clark & Snow (1975), and Salomon & Clark (1977).

Although the orientation could be extended to include the concurrent (or propaedeutic) study of environmental (Shulman, 1970) or ecologically apt (Bronfenbrenner, 1977) conditions surrounding inquiry (both of which trace back to Brunswik, 1956), this extension is not attempted here because a) some analytic power probably would be lost and b) the administrative burden to the inquiry would be increased. The environment of the table-using research is a classroom not in use by the school. It fails the test of ecological aptness in that research personnel are present, the situation is special, and participating students are aware that it is special. These ecological deficiencies are endurable because the inquiry is less concerned with productivity of the prevailing classroom than with demonstrating the proficiency levels upper elementary schoolers <u>are able to attain</u> when specified displays require processing.

3. METHODOLOGY

3.1 POPULATION

The designated population is those upper elementary schoolers--4th through 6th graders--who are sufficiently proficient in reading-decoding and inferencing skills that they score no lower than 18-19 on a 28-item screening device. Samples from the population--N = 1136 for 4th through 6th graders--suggest that, when the 18-19 screening score cut-off is used, approximately 90% of all upper elementary schoolers remain in the population. Consonant with basic skills assessment experience in general, sample screening score distributions are extremely skewed to the left, with scores in the 26-28 range predominating. For these samples, mean 4th grader performance on the screen is in the 24-25 range; that for 5th and 6th graders is in the 25-26 range.[3] Sampled students are further differentiated by grade level.

This approach to population specification removes most students having serious problems in reading decoding and provides (grade level) advice on general experience that is sufficiently undetailed that materials developers could respond to it without difficulty.[4]

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[3]Some of the table- and graph-using studies thus far conducted indicate that a few (5%) of the students accepted for participation following screening do not belong to a population proficient in reading decoding skill. Most of these students score 18-20.

[4]A more powerful approach would be to level the population (or samples therefrom) on the basis of proficiency levels for pertinent antecedent skills--e.g., reading decoding. Such an approach might pose difficulty for materials developers, who presently accede to the practice in many schools of beginning with grade-levelled materials and then accommodating individual achievement and related departures from grade level averages by moving some students up or down with respect to grade level classification for specified instructional purposes.

3.2 DISPLAY CHARACTERISTICS

Exploratory research in any area probably should stem from a priori constructions that fall between the extremes of impoverishment and super-elegance. If the construction is too simplistic, the resulting research must leave some major sources of variance undiscovered. Conversely, if a large number of display features are distinguished prior to research that compels these distinctions, much costly research will be devoted to nil or minor sources of variance. If everything allegedly matters some, then most everything surely matters little.

While it might be useful during early research featuring text displays to distinguish levels of complexity using judgmental techniques, this approach is unnecessary when numerical information fields are at issue. However, it is much easier to analytically characterize numerical information fields--or data fields--underlying tabular and graphic displays than to similarly characterize the fields underlying other kinds of non-text displays--e.g., maps and flowcharts.

Although the data field is a semantic construction underlying alternative displays, it is rendered concrete using the device of a standard tabular form. This standard display is titled, has row and column margins, and has a body whose entries lie at the intersection of given row and column margin categories or levels. The data field per se occurs in the body. It consists of R rows x C columns, whose product E (number of entries) is an a priori expression of data field extensiveness.

Given the RxC = E differentiation, one can entertain whether covarying R and C while holding E constant--e.g., 24 = 2x12 = 3x8 = 4x6 = 6x4, etc.--affects performance of specified table-using tasks. If so, then the shape of the RxC matrix is a condition on effects of data field extensiveness.

Although a more comprehensive differentiation occurs elsewhere (Follettie, 1978b), it suffices here to distinguish two types of complexity that can occur in data fields. Descriptions of these types--Complexity 1 and Complexity 2--are placed in Table 1 for ease of reference.

A study by Wright (1977) leads to the supposition that, when two or more factors occur in the column margin--Complexity 1 organization--performance should be better if the top-down layering of these factors follows order of mention in a task-levying query than if top-down layering departs from order of mention. For just as a complex procedure involving conditionalities is easier to follow if rendered in decision algorithmic form, it is easier to retrieve data from a table having a multifactor, factorially-organized column margin if one can work down from the top, rather than up or up and down from a level of entry. Ordering of factors relative to order of mention in queries, then, might be a condition on Complexity 1. Conditions on extensiveness and complexity occur at the surface--in the display rather than in the data field in its abstract sense.

A priori extensiveness of data fields is a linear function of number of entries. A priori Complexity 1 is a linear function of number of multilevel or multicategory factors reflected in the data field. A priori Complexity 2 is a linear function of number of levels of categorization (applied equally to however many factors are reflected in the data field).

While terms such as "low extent, low complexity" and "moderate extent, high complexity" might be used descriptively to distinguish between displays featured in a given investigation, the a priori characteristics of given displays (and others of their class) are specified in quantitative terms. It is expected that the difficulty with which a given task involving

Table 1

Descriptions of Complexity 1 and Complexity 2

Type	Description
Complexity 1	Imagine that a standard display always places a data field's first factor in the row margin. Every data field must reflect at least one multilevel or multicategory factor--e.g., states of the U.S., nations that are leading producers of wheat, students in a spelling class. If there is a second multilevel or multicategory factor--e.g., different times or periods of time, different descriptive or production measures--it is placed in the column margin. If there are three such factors, the second and third occur in the column margin--typically reflecting factorial (bxc) organization. Number of factors in the display epitomizes the Complexity 1 variable.
Complexity 2	This variable involves levels of categorization. Imagine a data field wherein RxC = 9x9 = 81. Let the data field be two-factor--a categorical row factor and a categorical column factor. Three levels of categorization are distinguished: • One-level. Let the row categories refer to selected states and the column categories to selected crops grown, with entries reflecting production magnitudes. The table then is a one-level 9x9 display in that both factors are at one level of categorization--coordinate states and coordinate crops. Such displays are instances of the two-factor displays of the Complexity 1 type. • Two-level. Let the matrix formed by the first eight rows and the first eight columns refer again to states and crops, with the ninth row reflecting crop totals across states and the ninth column state totals across crops. At one level occur the entries for coordinate states x coordinate crops (8x8). At a second level occur the crop (1x8) and state (8x1) total entries. (Ignored here, the entry at the ninth row-ninth column intersect reflects the eight-state x eight-crop total, which could be viewed as a third-level entry.) The table is a two-level 9x9 display in that both factors are at two levels of organization. Such displays can be further differentiated based on taking only the R or the C factor to two levels. • Three-level. Imagine yet another 9x9 table. At the first level, six crops are grown in six states--the basic data. Let three of the states be western states and three eastern. And let three of the crops be root crops and

three pole. Place the western states in rows 1-3, the eastern states in rows 5-7, the root crops in columns 1-3, and the pole crops in columns 5-7. At second level occur the subtotals for western and eastern states on a crop-by-crop basis (rows 4 and 8) and for root and pole crops on a state-by-state basis (columns 4 and 8). At third level occur the crop (row 9) and state (column 9) totals. (Ignored again, the entry at the ninth row-ninth column intersect reflects the total for states x crops, which could be viewed as a fourth-level entry.) The table is a three-level 9x9 display in that both factors are at three levels of organization. Such displays can be further differentiated based on taking only the R or the C factors to three levels. Or one can take one factor to two levels and the other to three. Further complications can be introduced by adding a third factor.

the use of a table is performed will increase as extensiveness or complexity of the data field increases. Just what form relations between performance and such display factors might take is left to empirical study.

The foregoing framework permits research that holds constant certain variables while varying others. It lends itself to small-scale factorial studies underlying investigation of joint effects of different factors. The intent is that findings relating to a specified population, display structure, task, and set of constraining conditions, obtained under sampling conditions, will apply when other student and display samples reflecting the population and display structure are substituted.

3.3 DISPLAY PROCESSING TASKS

It is likely that the principal justification for using tables is that tabled data are easier to overview and retrieve specified entries from than data presented in running text form. Some might contend that the content of a data field is more readily acquired when the display takes tabular form than when it takes running text form. This contention is not advanced here, since content learning presupposes a good deal more than a wise choice of display options. No content retention task is studied because it is assumed that display effects are less pronounced than instructional effects when content acquisition is at issue. In the present work, instructional effects are explored in a quite restricted sense under the heading of constraining conditions on performance.

A respondent might demonstrate proficient retrieval of information from a table without having much understanding of intended signification. Proficient retrieval of tabled information simply indicates mastery of

certain of the basic table-using skills distinguished by Otto & Chester (1976, Chapter 4). Hence, it is necessary also to devise tasks bearing on a respondent's comprehension of semantic content of a table.

When using tables, it is not unusual to find it necessary first to retrieve two or more entries--from one table or from adjacent tables--and then in some sense to summarize these entries--for example, by adding them. The investigator's interest in such cases is not whether the summarizing skill--e.g., adding two entries--has been mastered, but rather whether this skill can proficiently be performed when entries first must be retrieved from a somewhat complex display.

Most extensively studied were three types of tasks involving the retrieval of entries from the body of a table or of information contained in the row or column margin. The different types of retrieval are denoted simple, superlative, and comparative retrieval. These tasks are characterized in Table 2. Also studied were several tasks designed to shed light on understanding of information conveyed in the table's title and legends appearing in its row and column margins. These related tasks are grouped under a comprehension task rubric, more fully characterized in Table 2. Finally, an addend-summing task based on retrieving two entries from the same or different tables received brief study.

In the present work, tasks are levied using written queries, accompanied by a response mode instruction. Such a query-instruction combination, when accompanying a pertinent display, concretely specifies the task whose performance is solicited. Error of measurement considerations held in abeyance, a correct response in this situation is evidence

Table 2

Tasks Featured in the Research

Code	Description
R1	RETRIEVAL
R11	Simple Retrieval. The R11 task is levied by a query-instruction combination that directs the respondent to retrieve from an accompanying or cited display specified information occurring in the body or a row or column margin of the display. The respondent is asked to retrieve absolute digital information--an entry when row and column legends are specified or either of the other items in this trio when the other two are specified. The task is levied using one of three response-mode levying instructions: M1 (Circle mode). Find the answer in the table and circle it; M2 (Fill-in mode). Find the answer in the table and write it in the blank; M3 (Selected-response mode). Find the answer in the table and circle it among the alternatives shown below the query. Sample queries: M1 What was the population of Loredo in 1960? M2 The crew of the Buna-Lae caught ____ tons of crab in 1974. M3 In 1976, the farmers of Elvira grew 90 thousand tons of ___ . pears tree fruit grapes melons vine fruit
R12	Superlative Retrieval. The R12 task entails retrieving the largest or smallest item in a specified array. Although a tabular display is digital, the task entails analog comparisons. The task is levied using a selected-response-mode levying instruction (M3). Sample queries: M3 ___ grew the smallest amount of grapes. Elvira Grenada Indigo Ramona Saturna M3 Which of the valleys of Dar grew the most grain in 1976? Albert Fremont Morgan Carson Harper
R13	Comparative Retrieval. The R13 task entails retrieving a larger or smaller entry or producing entity than one that is specified. While not made explicit, when the display is a table, the R13 task entails retrieving a next largest or next smallest item in an array. All queries are M3. Sample queries:

M3 Which type of clothes did the Gamma Blue Planet produce less of than blouses in 1976?

coats jeans shoes shirts socks

M3 Ramona grew a larger amount of ___ than apples.

cherries grapes melons oranges peaches

R2 COMPREHENSION

Classified under the comprehension rubric are a variety of tasks addressing understanding of information conveyed by the display's title and row and column margin legends. R2 encompasses a range of tasks that could be further differentiated. All queries are M3. Sample queries:

M3 One kind of kitchen item mentioned in the table is ___ .

jars ladles ovens pans tongs

M3 The countries mentioned in the table are located on the ___ Planet.

Alpha Red Beta Green Gamma Blue Kitchenware Baby Green

M3 The table shows ___ of kitchen items produced.

dozens hundreds thousands millions billions

R3 ADDEND SUMMING

The R3 task entails locating two numerical entries--in the same or different tables--summing them, and writing down the sum in an appropriate cell of the same or a different table. The arithmetic is kept quite simple. A task-levying instruction entails production-mode responding (M4).

that the task is understood and that the respondent is able to perform the sequence of actions inherent in performing the task.

Tasks can be performed using alternative response modes. Tasks performed in different response modes do not always yield the same findings. Intuition suggests that the simple retrieval task is the one that a tabular display designer most often wishes to levy. Hence, three different response modes involving simple retrieval were studied: a) circling the solicited information in the display, b) finding the information in the display and writing it in the blank space of a fill-in query, c) finding the information in the display and circling it in a set of alternatives accompanying a selected-response query. The selected-response mode characterized all studies involving superlative and comparative retrieval and comprehension tasks. The addend-summing task entailed production-mode responding.

While not exhaustive of the range of tasks table designers might wish to levy when a table is introduced into educational materials, the foregoing are considered representative of such a range.

3.4 CONSTRAINING CONDITIONS

Two sorts of constraining conditions on performance are distinguished. The first type reflects instructionlike antecedent commentary clarifying the nature of the task. This could vary from nothing at all to a mini-course of instruction. The tendency was to use single-page directions consisting of a simple display and 2-4 queries, answers to which were critiqued prior to student negotiation of study exercises.

The second type of constraint relates to rate of performance. Students can be allowed to take as long as they wish to complete study exercises,

with time constraints neither mentioned nor implied. Conversely, they can be allowed limited time per response or exercise. Participants in the table-using research were encouraged not to waste time (to serve administrative objectives), and no secret was made of the fact that exercises were timed. However, they also were encouraged to view the production of correct answers as more important than speed.

3.5 ENVIRONMENT

The data collection situation was special business for participants and was so perceived. Still, many of its elements mirrored a student's home classroom. Typically, an experimenter administered study materials to a group of six or eight students in a classroom not in use at the school while a second experimenter performed similar work with a second group across the room. The students in most groups came from the same classroom. Where not, typically half the group came from one classroom and the rest from another classroom at the same grade level. Hence, participants were acquainted with many or all others in the group. The furniture and surroundings were similar to those of the home classroom. Two groups present, the background noise level was not unlike that in the home classroom. Participants seemed ill at ease only when assignments outstripped their proficiency levels.

Students in a group tended to be quite competitive. Although comparisons with classroom activity were not made, it is probable that attention and effort levels on the average were better in the data collection situation than in the classroom.

3.6 PERFORMANCE AND DERIVED MEASURES

Different classes of activity have different dimensions pertinent to the assessment of performance. Runners typically are assessed exclusively for speed. The world's fastest human is not stripped of his medals because his style can be likened to that of a concrete mixer on legs. Conversely, in Olympic walking events, eligibility turns on achieving criterion style; this criterion met, performance is assessed on the basis of speed. When driving a ball down a fairway, golfers are assessed for both distance and accuracy. Divers and ice skaters are judged along several dimensions. Hence, there is precedent for assessing performance along any given number of dimensions.

Although some apparently believe that cognitive performance merits assessment only for accuracy, for most educational tasks the pertinent assessment dimensions are accuracy and speed. The conditions of additivity met, measurements along neither of these dimensions need pose problems. If assessment items are apt reflections of the task at issue, then responses occurring under the response mode conditions cited in Table 2 can straightforwardly be categorized as correct or incorrect (and tallied). Response duration--herein the time taken to complete N items (a sample from the task domain)--can straightforwardly be measured.

Investigators do not typically report speed measures. Only when all respondents perform quite accurately does an investigator typically fall back on speed measures as a basis for distinguishing between treatment effects. Most investigators apparently do not subscribe to the view that adequate descriptions of performance in an educational setting should jointly consider accuracy and speed.

Faw & Waller (1976) have reviewed some of the pros and cons regarding the joint consideration of accuracy and speed measures when describing and analyzing scholastic performance. The issues are whether student time in the classroom is a free economic good and, if not, whether 400 years of mensuration technology provides a basis for wedding the accuracy and time measures.

In the present research, both accuracy and speed measures are taken. The measures of analysis are accuracy per se (proportion of responses correct) and the derived measure accuracy/time (scaled to reflect number of correct responses per minute).

The usual arguments against the accuracy/time measure take two forms. First, some question the aptness of the measure on pedagogical grounds. With suitable obfuscation, those adopting this position argue that student time indeed is a free economic good. It is in the nature of earliest instruction in anything that appreciable expenditures of time can--indeed must--be afforded. However, even in education, the apprentice is expected not to take too long to ascend to that universe of action where "Time is money."

Others question the measure on technical grounds. The typical technical agrument against the measure finds faint pleasure with the division sign intruding between its accuracy and time components. It is well enough, the technical demurrers seem to say, to place such a sign between lifeless mass and volume, but to impute a densitylike character to performance is simplistic. However, in a display-using context, all philosophers should be able to understand that, if two displays cover essentially the same ground, the one that is effectively processed most quickly should be preferred.

In most cells of most research designs, students will vary both for accuracy and for speed. One cannot fall back on "Accuracy equal, what is the speed picture?" At least this cannot be done without resorting to a radical use of covariance analysis. I am more comfortable with the accuracy/speed measure than with covariance analysis involving performance data. Moreover, the data at hand warrant the view that the accuracy/time measure more nearly meets the assumptions underlying use of the analysis of variance than does the accuracy measure.

One way to insure that scores in an array distribute normally is to extremely artificialize (heterogenize) the task domain--e.g., by having respondents attempt some tasks that most can accomplish and some tasks that few can accomplish and some tasks that fall in between. Those who are more analytically inclined and who are interested in some tasks that are well within the competencies of most respondents occasionally will encounter data arrays reflecting pronounced ceiling effects for accuracy. When this happens--because many respondents provide errorless performance--mean accuracy will be high and affected cell distributions within an experimental design will be sharply skewed to the left. Imagine a score range from 0 to 10. If the score distribution peaks at 8 and is significantly non-normal, it can be normalized using some form of mathematical transformation applied to scores of the array. But if the score distribution peaks at 10--not unusual in research spanning a range of levels of difficulty--there is no sensible means whereby the distribution can be normalized. Such data speak eloquently and unambiguously--but not in a language to which the analysis of variance is attuned (nor nonparametric alternatives to it either, when the tail of the distribution is sparsely populated).

Conversely, cell distributions for accuracy/time almost always meet the normality assumption underlying the use of analysis of variance. Where they do not, or where failing to meet a second assumption--that cell variances be homogeneous--these distributions almost always can be brought into conformity with these assumptions through application of a square-root or similar transformation. Accuracy/time often is a more suitable measure for statistical analysis than accuracy per se because the derived measure is less sensitive to ceiling effects.

The accuracy/time measure can be defeated only if chance performance is frequent, is reflected by a positive accuracy score, and is the occasion for superspeedy performance (based on an unwillingness to try). This combination of circumstances will seldom be experienced. Where encountered, it can be defensed in a number of ways--e.g., by regarding all accuracy scores below chance value as zero scores and by subtracting the chance value from all other scores.

3.7 GENERAL METHOD

Students were screened in class-size groups in their home classrooms a few days prior to data collection proper. The primary purpose of the screening procedure was to excuse those having quite serious difficulties with reading decoding. Screening lowered the time required by data collection sessions while providing estimates of the proportion of all 4th through 6th graders to which findings could be expected to apply.

Nine elementary schools--most of them K-6--in six school districts of Los Angeles and Orange Counties participated in the research, which made use of 844 students--32 3rd graders, 286 4th graders, 183 5th graders, and 343 6th graders--in a series of investigations.

Data collection sessions occurred in an empty classroom of the school, usually during morning hours. In most investigations, student participation ranged from 20 to 30 minutes. A few sessions extended to 35 or 40 minutes. In one study, sessions were of 60 minute length.

All students participated in at least one investigation. Many students participated in a study (an investigation whose participants had not previously participated in kindred research) and immediately thereafter participated in a probe (an investigation whose participants earlier participated in one kindred study). Although preliminary reports (Follettie, 1978c, 1978d, 1978e) distinguish eight studies and eight probes, some of these elements of investigation simply were administratively convenient chunks of work.

During a data-collection session, an experimenter administered study materials to previously-screened participants in groups of six or (in most instances) eight. All students in a group were at the same grade level. In a given investigation, as many treatment combinations as could be distributed over the group were so distributed. Hence, the group usually reflected the study in microcosm, exclusive of the grade level factor.

Following preliminary task-clarifying directions, participants of a group responded to one or more blocks of queries referring to pertinent displays. Performance was timed on a per block basis. Typically, a block encompassed 10 queries. Each query of a block usually exemplarized the same task. Each query addressed one of from one to five displays used in the block. Each display exemplarized the same structural features, varying only for content.

Accuracy measures reflected the proportion of responses correct per block. Accuracy/time measures were derived by multiplying number of correct responses per block by 60 and dividing this product by the block response times in seconds. Both types of data were analyzed.

Where a factor was treated as within-subjects in the experimental design, different levels of the factor were reflected in different blocks of a sequence. In such cases, the blocks of a sequence were counterbalanced for order.

3.8 MATERIALS

Exemplary materials are presented in Appendix A. The complete materials used in the table-using research are on file at SWRL Educational Research and Development.

3.9 RESEARCH DESIGNS

The reported research consists of eight studies (numbered 1, 2,..., 8) and eight probes (numbered 1A, 1B, 2A, 2B, 3A, 3B, 4A, 7-8A). The research designs for these investigations are paradigmatically described in Table 3. Additional detail is provided in Table 4 (Section 4). The typical design is a simple or mixed factorial structure involving 2-4 "levels" of 2-4 factors, one of which is grade level. The remaining commentary in this section concerns the nature of some of the factors studied.

Display format (Study 1). This "factor" encompasses three alternative tabular and one paragraphic means for displaying an 8-entry data field and associated row and column marginal information. In the first tabular format, the data field consists of 8 rows x 1 column. In the second, the bottom half of the 8x1 display is placed to the right of the top half--a procedure

Table 3
Design Resumes for Table-Using Research

Study or Probe	Number Students	No. Cells	Cell n	Between-Subjects		Within-Subjects		Design
				Factors	Levels	Factors	Levels	
1	96[a]	24[a]	4	A = Display Format B = Directions C = Grade Level	a = 4; (8x1)x1, (4x1)x2, (2x1)x4 Tables, Paragraph b = 2; Scant, Modest c = 3; 4th, 5th, 6th	D = Query Block (Practice)	d = 2; 1st, 2nd Blocks of 10	axbxcxn=4x2x3x4=96; d=2, N=192
1A	36	6	6	A = Placement of MSMT Unit Labels B = Grade Level	a = 2; Table's Title, Column Margin b = 3; 4th, 5th, 6th			axbxn=2x3x6=64=N
1B	36	6	6	A = Entry Features B = Grade Level	a = 2; 3-Digit Whole, Decimal No. b = 3; 4th, 5th, 6th			axbxn=2x3x6=64=N
2	72	18	4	A = Row-Column Ratio B = Column Orderability C = Grade Level	a = 3; RxC = 12x2, 6x4, 3x8 b = 2; Columns with Low Logical Orderability or High c = 3; 4th, 5th, 6th	D = Query Block (Practice)	d = 2; 1st, 2nd Blocks of 10	axbxcxn=3x2x3x4=72; d=2, N=144
2A	36	6	6	A = No. Entries B = Grade Level	a = 2; 7x7=49, 12x12=144 b = 3; 4th, 5th, 6th			axbxn=2x3x6=36=N
2B	36	6	6	A = Type of Task B = Grade Level	a = 2; R12/M3, R13/M3 b = 3; 4th, 5th, 6th			axbxn=2x3x6=36=N
3	210	21	10	A = Complexity 2 B = Grade Level	a = 7; 1111, 1211, 1112, 1212, 1311, 1131, 1313 b = 3; 4th, 5th, 6th	C = Query Block (Practice)	c = 2; 1st, 2nd Blocks of 10	axbxn=7x3x10=210; c=2, N=420

[a] Excludes 32 3rd graders in 8 cells.

Table 3 (Page 2)

Study or Probe	Number Students	No. Cells	Cell n	Between-Subjects		Within-Subjects		Design
				Factors	Levels	Factors	Levels	
3A	120	12	10	A = Scanning Plane B = Type of Task C = Grade Level	a = 2; Row, Column Scan b = 2; R12/M3, R13/M3 c = 3; 4th, 5th, 6th	D = Control Factor (ACC Measure only)	d = 2; R12 or R13 (Odd-Numbered Queries), R11/M3 (Even-Numbered Queries). Students Responded to 6 R11 + 6 R12 or R13 Queries	axbxcxn=2x2x3x10=120; d=2, N=240
3B	90	9	10	A = Row Factor B = Grade Level	a = 3; Continuous Ex Temporal (X), Categorical (U), Temporal (Y) b = 3; 4th, 5th, 6th			axbxn=3x3x10=90=N
4	80	8	10	A = Number of Column Factors (Complexity I) B = Grade Level	a = 4; 1(1x8), 2(2x4), 3(2x2x2), 3(2x2x2)* b = 2; 5th, 6th	C = Query Block (Practice)	c = 2; 1st, 2nd Blocks of 10	axbxn=4x2x10=80; c=2, N=160
4A	80	8	10	A = Type of Display B = Grade Level	a = 4; Table, Circle Graph, Vertical Bar Graph, Horizontal Bar Graph b = 2; 5th, 6th			axbxn=4x2x10=80=N
5	34	2	17	A = Grade Level	a = 2; 5th, 6th	B = Level of Complexity (Intuitive)	b = 2; "Simple" (4 Table-Task Combos), "Complex" (4 Table-Task Combos)	axn=2x17=34; b=2, N=68

*The first three categories reflect increasing formal complexity along one dimension. The last two reflect increasing task complication along a second dimension. For the starred level only, column margin organization is inconsonant with order of mention of factors in the query.

Table 3 (Page 3)

Study or Probe	No. Students	No. Cells	Cell n	Between Subjects		Within Subjects		Design
				Factors	Levels	Factors	Levels	
6	256	16	16	A = Complexity 2 B = Directions C = Grade Level D = Screening Level	a = 2; 1111, 1313 b = 2; Scant, Modest c = 2; 4th, 6th d = 2; High, Low			axbxcxdxn=2x2x2x2x16=256=N
7	32	4	8	A = Type of Legend B = Grade Level	a = 2; "Old Legends," "New Legends" b = 2; 4th, 6th	C = Query Block (Practice)	c = 2; 1st, 2nd Blocks of 10	axbxn=2x2x8=32; c=2, N=64
8	32	4	8	A = Type of Practice B = Grade Level	a = 2; Passive, Active b = 2; 4th, 6th	C = Query Block (Practice)	c = 2; 1st, 2nd Blocks of 10	axbxn=2x2x8=32; c=2, N=64
7-8A	64	8	8	A = Scanning Plane B = No. Addend Displays C = Grade Level	a = 2; Horizontal, Vertical b = 2; 1(2x7 or 7x2), 2(2x4+2x4 or 4x2+4x2) c = 2; 4th, 6th			axbxcxn=2x2x2x8=64 =N

sometimes used when a long and narrow table can thereby be "squared." In the third, successive quarters of the display occur to the right of the preceding quarter. In the paragraphic format, the data are conveyed in running text. A within-factor comparison of performance referencing tabular and paragraphic formats inheres in this "levelling" arrangement.

Task-clarifying directions (Studies 1 and 6). Directions were scant or modest. Scant directions simply illustrated that a specified data entry is associated with a row entity to its left and a column entity above. Modest directions entailed that students respond to a few representative queries addressing the use of an exemplary table and that these responses be critiqued. Modest directions typically consumed two minutes per participating student. In all studies save Studies 1, 5, and 6, directions were modest.

Placement of measurement unit labels (Probe 1A). Imagine a table whose two columns refer to the production of meat in pounds and eggs in dozens by specified producers. Minimal labels for columns are "Meat" and "Eggs." One can either use these minimal labels for the columns and indicate units of measurement in the table's title--"Pounds of Meat and Dozens of Eggs Produced by. . ."--or can use column labels showing units of measurement--"Pounds of Meat," "Dozens of Eggs." The placement factor has these alternative loci as its levels.

Entry features (Probe 1B). Tables were constructed which made equal sense whether entries were 3-digit whole numbers or one-tenth expressions of these numbers. If an entry under the whole number condition was 308, it was 30.8 under the decimal number condition.

Row-column ratio (Study 2). One can vary the configuration of a data field while holding constant the number of entries in the data field. A table having 12 rows x 2 columns (12x2) configuration, one having 6x4 configuration, and one having 3x8 configuration all reflect 24-entry data fields. These were the "levels" of this factor studied in Study 2.

Type of task. One or more types of task were studied in every investigation. The different types of task and their response mode conditions are described earlier in Table 2.

Column orderability (Study 2). Imagine a multicolumn table whose rows reflect geographic entities and whose columns reflect various measures of these entities--e.g., mean temperature, annual rainfall, land area, population. Conversely, let the different columns refer to specified production in successive decades. Columns of the first table have a low level of orderability on logical grounds, which might hamper retrieval performance. Columns of the second table might have high orderability, are well ordered, and might facilitate retrieval.

Complexity 2 (Studies 3 and 6). This factor was previously described in Table 1. The 4-digit Table 3 notation for levels of the factor are interpreted as follows:

- The first digit denotes number of row factors.
- The second, number of levels of organization for the row factor.
- The third, number of column factors.
- The fourth, number of levels of organization for the column factor.

The complexity codes of Table 4 are similarly interpreted.

Scanning plane (Probes 3A and 7-8A). For one level of this factor, the query-levied task entails a row or horizontal scan. For the other level, the task entails a column or vertical scan.

Row factor (Probe 3B). Three levels are distinguished: a continuous row factor--exclusive of temporal factors--such as length or volume (denoted X), a categorical row factor (denoted U), and a temporal factor (denoted T). Tabled functional relations feature an X row factor. Demographic data typically feature a U row factor. Data fields whose row factor is U probably are more common in the experience of upper elementary schoolers.

Complexity 1 (Study 4). This factor was previously described in Table 1. Featured tables reflect from one to three factors in the column margin.

Screening level (Study 6). One level of this factor encompasses students scoring in the higher range on a 28-item screening device. Most high screen students scored in the 25-28 range. The second level encompasses accepted students scoring lower. Most low screen students scored in the 18-25 range.

Type of legend (Study 7). Prior to this investigation, complex tables of the sort featured in Studies 3 and 6 used row and column legends at the second (subtotal) and third (total) levels of organization which were implicit in the sense that the added lower-level rows and columns were not specifically cited in the second and third level legends. Earlier research suggested that this might pose a problem. The "old legends" of Study 7 are the implicit (standard) ones. The "new legends" specify rows or columns pertinent to summing operations.

Type of practice (Study 8). A passive practice condition entailed inspecting four queries whose correct answers were supplied during the course of negotiating task-clarifying directions. An active practice

condition entailed providing answers to these practice queries. These answers then were critiqued before the student was advanced to the data collection session proper.

Grade level. The first series of investigations (1 through 2B) were conducted in December 1977; the second series (3 through 5) in January 1978; the third series (6 through 7-8A) in March 1978. Hence, attained grade level advanced slightly during the course of the research from on the order of 4.33, 5.33, and 6.33 during the first series to 4.67 and 6.67 during the last series. That is, third series participants were a third of a school year beyond their first series counterparts.

4. FINDINGS

Findings are summarized under the headings of mean performance, statistical analyses, and additional analyses.

4.1 MEAN PERFORMANCE

The cell-level performance means for the accuracy and accuracy/time measures are presented for the different investigations in Table 4, along with other information characterizing the cells and major control conditions for the investigation.

4.2 STATISTICAL ANALYSES

Parameter-hunting was not a prime objective of the reported research, since one can easily find many more factors having statistically reliable effects than one knows what to do with. However, we did wish to determine some of the more important conditions under which degraded performance can be expected if no compensatory (informative, educational) actions are instituted. Hence, most factors yielding statistically reliable differences (between "levels" means) are inventoried in Table 5. Those investigations in which the factor had statistically reliable effects and those in which it did not are enumerated, with positive effects characterized by measure.

4.3 ADDITIONAL ANALYSES

Although conditions varied from investigation to investigation, certain portions of the data can be brought together to illustrate the quantitative effects of certain of the factors.

Table 4
Accuracy and Accuracy/Time Means for Table-Using Research

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)		(9)	(10)				(11)			
STUDY OR PROBE	TASK-CLARIFYING DIRECTIONS	SCREEN LEVEL	TASK/MODE	EXTENT = NO. ENTRIES	COMPLEXITY CODE, RELATED FACTORS	OTHER FACTORS (HEREIN ONTABULATED), SELECTED GRADE MEANS	NO. STUDENTS PER GRADE	NO. STUDENTS ACROSS GRADES	NO. QUERIES	ACCURACY 4TH	ACCURACY 5TH	ACCURACY 6TH	ACCURACY MEAN	ACCURACY/TIME 4TH	ACCURACY/TIME 5TH	ACCURACY/TIME 6TH	ACCURACY/TIME MEAN
1	SCANT	--	R11/M1	8	1100 CONVENTIONAL TABLE	PRACTICE EFFECTS	4	12	20	.99	1.00	1.00	1.00	4.3	5.4	6.5	5.4
					1100 TABLE (2 COL. UNITS)		4	12	20	.97	.99	.91	.96	3.6	5.5	5.8	5.0
					1100 TABLE (4 COL. UNITS)		4	12	20	.99	.94	.80	.91	3.8	4.2	4.9	4.3
					1100 PARAGRAPH		4	12	20	.99	1.00	.99	.99	3.2	4.4	5.1	4.2
	MODEST	--	R11/M1	8	1100 CONVENTIONAL TABLE	PRACTICE EFFECTS	4	12	20	1.00	.97	.99	.99	4.9	4.7	6.3	5.3
					1100 TABLE (2 COL. UNITS)		4	12	20	1.00	1.00	.99	1.00	6.9	4.2	6.0	5.7
					1100 TABLE (4 COL. UNITS)		4	12	20	1.00	.95	1.00	.98	6.4	4.2	7.5	6.1
					1100 PARAGRAPH		4	12	20	.99	.99	1.00	.99	5.0	3.9	5.5	4.8
						MEAN: SCANT DIRECTIONS	16	48	20	.98	.98	.92	.96	3.7	4.9	5.6	4.7
						MEAN: MODEST DIRECTIONS	16	48	20	1.00	.98	.99	.99	5.8	4.2	6.3	5.4
						MEAN: TABLES	24	72	20	.99	.97	.95	.97	4.8	4.7	6.2	5.2
						MEAN: PARAGRAPHS	8	24	20	.99	.99	.99	.99	4.1	4.3	5.3	4.6
1A	MODEST	--	R11/M3	36	1111 MSMT UNIT LABELS IN TITLE		6	18	10	.87	1.00	.85	.91	3.1	4.7	3.2	3.7
					1111 MSMT UNIT LABELS IN TABLE		6	18	10	1.00	1.00	1.00	1.00	3.7	4.0	5.0	4.2
						MEAN:	12	36	10	.93	1.00	.92	.95	3.4	4.4	4.1	3.9
1B	MODEST	--	R11/M2	36	1111 WHOLE NO. ENTRY (e.g., 308)		6	18	10	.92	.98	.88	.93	5.1	6.0	6.2	5.8
					1111 DECIMAL NO. ENTRY (e.g., 30.8)		6	18	10	.98	1.00	.95	.98	4.8	4.8	6.7	5.4
						MEAN:	12	36	10	.95	.99	.92	.95	4.9	5.4	6.5	5.6
2	MODEST	--	R11/M1	24	1111 UNORDERED COLUMNS	PRACTICE EFFECTS	12	36	20	.92	.91	.96	.93	3.4	4.3	5.0	4.2
					1111 ORDERED COLUMNS	ROW-COL. RATIO (12x2, 6x4, 3x8)	12	36	20	.97	.99	.86	.94	4.5	5.6	5.9	5.3
						MEAN	24	72	20	.94	.95	.91	.93	3.9	4.9	5.4	4.7
2A	MODEST	--	R11/M1	49	1111		6	18	10	.90	1.00	1.00	.97	4.5	7.4	6.2	6.0
				144	1111		6	18	10	.97	.85	.78	.87	3.4	4.0	4.3	3.9
2B	MODEST	--	R12/M3	49	1111		6	18	10	.92	.98	.88	.93	2.3	3.5	3.4	3.1
			R13/M3	49	1111		6	18	10	.87	.88	.90	.88	2.4	2.0	2.4	2.3
						MEAN	12	36	10	.89	.93	.89	.91	2.4	2.8	2.9	2.7

Table 4 (page 2)

STUDY OR PROBE	TASK-CLARIFYING DIRECTIONS	SCREEN LEVEL	TASK/MODE	EXTENT = NO. ENTRIES	COMPLEXITY CODE, RELATED FACTORS	OTHER FACTORS (HEREIN UNTABULATED), SELECTED GRADE MEANS	NO. STUDENTS PER GRADE	NO. STUDENTS ACROSS GRADES	NO. QUERIES	ACCURACY 4TH	ACCURACY 5TH	ACCURACY 6TH	ACCURACY MEAN	ACCURACY/TIME 4TH	ACCURACY/TIME 5TH	ACCURACY/TIME 6TH	ACCURACY/TIME MEAN
3	MODEST	--	R11/M1	81	1111 CONVENTIONAL TABLE 1211 (9TH) ROW TOTAL 1112 (9TH) COL. TOTAL 1212 ROW + COL. TOTALS 1311 ROW SUBTOTALS AND TOTAL 1113 COL. SUBTOTALS AND TOTAL 1313 R + C SUBTOTALS AND TOTALS	PRACTICE EFFECTS	10	30	20	.87	.96	.98	.94	3.8	5.0	5.1	4.7
							10	30	20	.97	.94	.98	.94	4.6	4.6	5.2	4.8
							10	30	20	.91	.96	.95	.94	4.1	4.6	5.0	4.6
							10	30	20	.86	.86	.92	.88	3.0	3.8	4.6	3.8
							10	30	20	.74	.88	.83	.82	2.1	3.0	3.0	2.7
							10	30	20	.72	.83	.94	.83	1.9	2.5	4.4	2.9
							10	30	20	.75	.71	.81	.77	1.4	1.7	2.6	1.9
						MEAN: 1111 + 1211 + 1112	30	90	30	.92	.96	.97	.95	4.2	4.7	5.1	4.7
						MEAN: 1311 + 1113	20	60	20	.73	.86	.88	.82	2.0	2.7	3.7	2.8
3A	MODEST	--	R11/M3	81	1111 (NOTE. EACH STUDENT	SCANNING PLANE	(40)	(120)	6	.91	.92	.98	.93	CANNOT BE CALCULATED			
			R12/M3	81	1111 RESPONDED TO 6 R11 QUERIES		20	60	6	.90	.86	.92	.90				
			R13/M3	81	1111 + EITHER 6 R12 or R13 QUERIES.)		20	60	6	.81	.75	.85	.81				
						MEAN	40	120	12	.89	.86	.94	.90	2.5	3.0	3.5	3.0
3B	MODEST	--	R11/M1	81	1111 CONTINOUS ROW FACTOR (X) 1111 CATEGORICAL ROW FACTOR (U) 1111 TEMPORAL ROW FACTOR (T)		10	30	10	.87	.86	.83	.85	3.0	4.0	3.6	3.5
							10	30	10	.92	.85	.96	.91	3.5	3.8	5.3	4.2
							10	30	10	.77	.95	.96	.89	3.0	4.5	5.2	4.2
						MEAN	30	90	10	.86	.89	.92	.88	3.2	4.1	4.7	4.0
4	MODEST	--	R11/M1	80	1111 COL. HAR. ORG.: 1 x 8 1121 " : " " 2 x 4 1131 " " " 2 x 2 x 2 1131 " " " 2 x 2 x 3*	PRACTICE EFFECTS *FOR THIS CONDITION ONLY, FACTOR ORDER OF MENTION IN QUERY IS INCONSONANT WITH COL. HAR. ORG.	10	30	20	--	.97	.99	.98	--	4.8	6.6	5.7
							10	30	20	--	.91	.87	.89	--	3.6	4.1	3.8
							10	30	20	--	.76	.89	.83	--	2.3	3.1	2.7
							10	30	20	--	.67	.74	.70	--	1.9	2.5	2.2
4A	MODEST	--	4 R11/M3+ 2 R12/M3+ 2 R13/M3	9	1100 TABLE 1100 CIRCLE GRAPH 1100 VERTICAL BAR GRAPH 1100 HORIZONTAL BAR GRAPH		10	30	8	--	1.00	.99	.99	--	3.9	5.7	4.8
							10	30	8	--	.95	.97	.96	--	4.2	5.3	4.7
							10	30	8	--	.96	1.00	.98	--	5.0	6.3	5.6
							10	30	8	--	.96	.91	.94	--	5.0	5.4	5.2
						MEAN: R11/M3	40	80	4	--	.99	.98	.98	CANNOT BE CALCULATED			
						MEAN: R12/M3 + R13/M3	40	80	4	--	.95	.96	.95				

Table 4 (page 3)

STUDY OR PROBE	TASK-CLARIFYING DIRECTIONS	SCREEN LEVEL	TASK/MODE	EXTENT = NO. ENTRIES	COMPLEXITY CODE, RELATED FACTORS	OTHER FACTORS (HEREIN UNTABULATED), SELECTED GRADE MEANS	NO. STUDENTS PER GRADE	NO. STUDENTS ACROSS GRADES	NO. QUERIES	ACCURACY 4TH	ACCURACY 5TH	ACCURACY 6TH	ACCURACY MEAN	ACCURACY/TIME 4TH	ACCURACY/TIME 5TH	ACCURACY/TIME 6TH	ACCURACY/TIME MEAN
5	15-MIN. LECTURE	--	SEE COL. 6	81	"SIMPLE": 1111 (R11/M3) + 1212 (R11/M3) + 1111 (R2/M3) + 1111 (R13/M3)		(17)	(34)	20	--	.90	.97	.94	CANNOT BE CALCULATED			
			R11/M1	80-81	"COMPLEX": 1111 (UNORDERED COLUMNS) + 1313 + 1121 + 1131		(17)	(34)	20	--	.82	.84	.83				
						MEAN	17	34	40	--	.86	.91	.88	--	1.7	2.2	1.9
6	SCANT	HIGH	SEE COL. 6	81	1111 (5 R11 + 5 R12 + 5 R13 + 5 R2)/M3		16	32	20	.83	--	.88	.85	3.4	--	3.2	3.3
					1313 SAME		16	32	20	.50	--	.56	.43	1.0	--	1.8	1.4
		LOW	SEE COL. 6	81	1111 SAME		16	32	20	.59		.62	.60	2.5	--	2.5	2.5
					1313 SAME		16	33	20	.35	--	.35	.35	1.2	--	1.2	1.2
	MODEST	HIGH	SEE COL. 6	81	1111 SAME		16	32	20	.89	--	.87	.88	3.8	--	3.8	3.8
					1313 SAME		16	32	20	.38	--	.51	.44	1.1	--	1.6	1.3
		LOW	SEE COL. 6	81	1111 SAME		16	32	20	.70	--	.76	.73	3.0	--	3.6	3.3
					1313 SAME		16	32	20	.31	--	.41	.36	1.3	--	1.6	1.4
					NOTE: A DESIGN POSITION BIAS FAVORS R11 AND R13.	MEAN: R11/M3 (1111 + 1313)		256	5				.62				CANNOT BE CALCULATED
						MEAN: R12/M3 (1111 + 1313)		256	5				.55				
						MEAN: R13/M3 (1111 + 1313)		256	5				.60				
						MEAN: R2/M3 (1111 + 1313)		256	5				.55				
7	MODEST	--	R11/M1	81	1313 "OLD LEGENDS"	PRACTICE EFFECTS	8	16	20	.46	--	.83	.64	1.1	--	2.1	1.6
					1313 "NEW LEGENDS"		8	16	20	.59	--	.79	.69	1.4	--	2.4	1.9
						MEAN: LEGENDS	16	32	20	.52	--	.81	.66	1.2	--	2.2	1.7
						MEAN: QUERY TO 1ST LEVEL OF ORG.	16	32	10	.66	--	.91	.78	CANNOT BE CALCULATED			
						MEAN: QUERY TO 2ND, 3RD LEVELS OR ORG.	16	32	10	.39	--	.71	.55				
8	MODEST	--	R11/M3 + R2/M3	81	1313 "NEW LEGENDS," PASSIVE PRACTICE	PRACTICE EFFECTS	8	16	20	.49	--	.72	.60	.9	--	1.7	1.3
					1313 "NEW LEGENDS," ACTIVE PRACTICE		8	16	20	.44	--	.54	.49	.7	--	1.1	.9
						MEAN:	16	32	20	.46	--	.63	.54	.8	--	1.6	1.1
7-8A 8A	MODEST	--	R3/M4	14	1111 (7 x 2)		8	16	6	.98	--	.87	.93	5.3	--	10.8	8.1
				16	1111 (4 x 2) BESIDE 1111 (4 x 2)		8	16	6	.69	--	.87	.78	2.4	--	6.2	4.3
				14	1111 (2 x 7)		9	16	6	.85	--	.85	.85	4.4	--	7.4	5.9
				16	111' (2 x 4) ABOVE 1111 (2 x 4)		8	16	6	.33	--	.85	.59	1.0	--	4.5	2.7
						MEAN: 1 TABLE	16	32	6	.91	--	.86	.89	4.8	--	9.1	7.0
						MEAN: 2 TABLES	16	32	6	.51	--	.86	.68	1.7	--	5.3	3.5

Table 5
Principal Observed Statistically Reliable ($p < .05$) Differences

Factor	Studies with $p < .05$				Studies with $p > .05$	
	Accuracy		Accuracy/Time		Acc	A/T
	No.	Study Codes	No.	Study Codes	No.	No.
GRADE LEVEL	6	3, 4, 5, 6 (Hi C), 7, 7-8A	13	1B, 2, 2A, 3, 3A, 3B, 4, 4A, 5, 6 (Hi C), 7, 8, 7-8A	10	3
PRACTICE	2	1, 4	5	1, 2, 4, 7, 8	4	1
SCREENING LEVEL	1	6 (Lo C)	1	6 (Lo C)	0	0
EXTENT	0		1	2A	1	0
COMPLEXITY						
Type 2	2	3, 6	2	3, 6	0	0
Type 1	1	4	1	4	0	0
Intuitive	1	5*	0		0	0
Orderability of Columns	0		1	2	1	0
DIRECTIONS	1	6 (Lo C)	1	1	1	1
TYPE OF TASK	2	3A*, 8	1	2B	1	1
COL MARGIN ORG RELATIVE TO QUERY ORG	1	4	0		0	1
NO. ADDEND DISPLAYS	1	7-8A (4th grade)	1	7-8A	0	0
TOTALS	18		27		18	7

*In these studies, the A/T measure cannot be calculated for the factor at issue.

Note. Were interstudy analyses undertaken, it is probable that number of tasks levied per 20 queries would reflect statistically reliable differences between means for the accuracy measure; a similar finding should occur for the response mode factor using the A/T data.

4.31 Extensiveness. Figure 1 reflects means for those modestly directed 4th-6th graders responding to RII/MI queries addressing simpler tables. Although the data base is too restricted to warrant quantification of effects, it is entertainable in light of the plots and freehand fits presented in the figure that performance should decline little as a function of extensiveness for tables larger than 81-entry (e.g., 9x9) under the cited conditions. When the task is more challenging or the table is more complex, performance might decline over a broader range of the extensiveness factor.

It is evident that when conditions are comparable--the study plots of Figure 1, the probe plots--the accuracy and accuracy/time functions of extensiveness take similar form.

4.42 Complexity 2. According to formal specifications, Study 3 reflects five levels of complexity based on levels of organization of row and column margins--1111, one level of organization, both margins; 1211 + 1112, one level of organization for one margin, two levels for the other margin; 1212, two levels of organization, both margins; 1311 + 1113, one level of organization for one margin, three levels for the other margin; 1313, three levels of organization, both margins. However, the data (Table 4) suggest that tables reflecting the first two of these levels of complexity of the second type do not differentially affect table-using performance. Pooling the first two levels (and the pertinent Study 3 data), the levels structure is: Level 1, 1111 + 1211 + 1112; Level 2, 1212; Level 3, 1311 + 1113; Level 4, 1313. Given this structure, table-using accuracy and accuracy/time become approximately linear declining functions of increasing complexity of the second

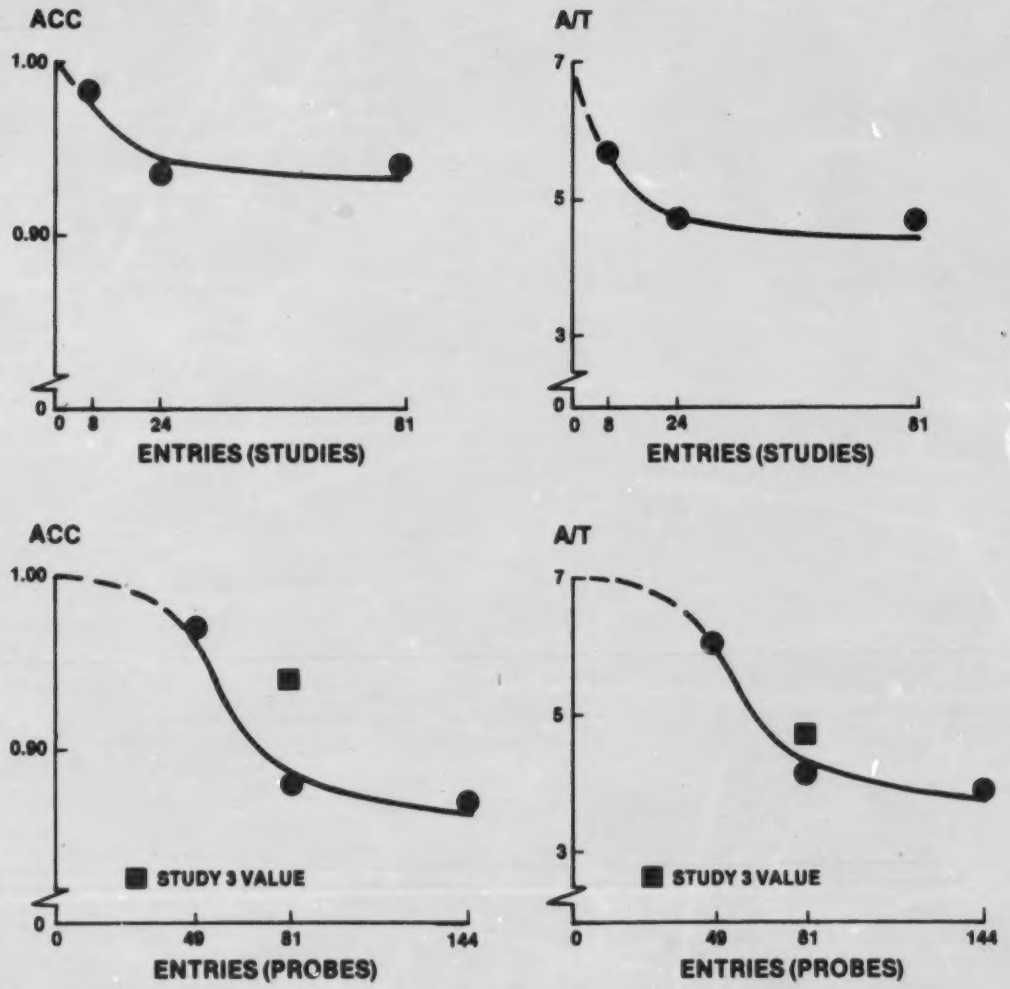

Figure 1. Accuracy and Accuracy/Time Performance as Functions of Number of Entries in the Table. Study data: 8-entry, Study 1, modest directions, all table conditions; 24-entry, Study 2, both conditions; 81-entry data, Study 3, 1111, 1211, 1112 conditions. Probe data: 49-entry, Probe 2A; 81-entry, Probe 3B, all conditions; 144-entry, Probe 2A.

type, as illustrated in Figure 2. Letting C=1 for Level 1, C=2 for Level 2, etc., the functions are:

$$Acc = 1 - .06C.$$

$$A/T = 5.6 - .9C.$$

These functions apply under the conditions for Study 3--modest directions, simple retrieval task (R11), circle mode (M1). Performance might decline more sharply as a function of C under more challenging conditions--e.g., scant directions, superlative or comparative retrieval task, fill-in or selected-response mode.

It is evident that the accuracy and accuracy/time functions of Complexity 1 take quite similar form.

4.43 Complexity 1. Study 4 reflects three levels of formally specified complexity based on number of factors factorially organized in an 80-entry table's 8-column margin--1111, eight levels of one factor; 1121, four levels of one factor x two levels of a second factor; 1131, two levels of one factor x two levels of a second factor x two levels of a third factor. The pertinent data are the top three lines of the Study 4 portion of Table 4, wherein column margin organization is consonant with order of mention of factors in the task-levying query. These data suggest that accuracy and accuracy/time are declining, slightly negatively accelerated functions of Complexity 1, illustrated in Figure 3. Simple retrieval becomes progressively more difficult with increasing number of factorially organized factors in the column margin, but the 2-3 factor decrement is slightly smaller than the 1-2 factor decrement.

As is true for Complexity 1, the accuracy and accuracy/time functions of Complexity 2 take quite similar form.

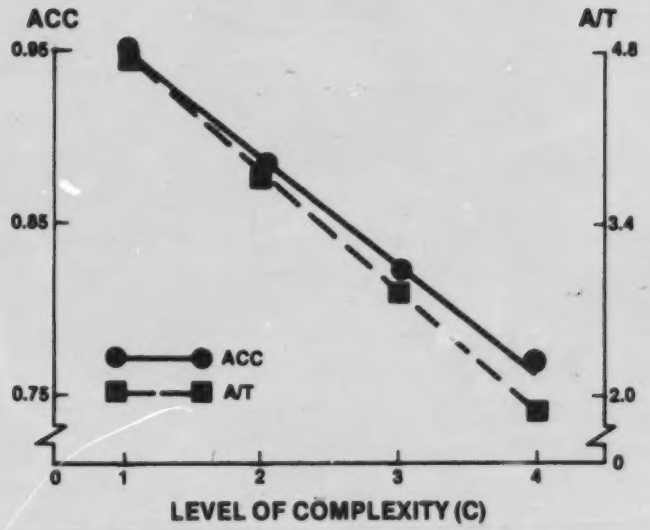

Figure 2. Accuracy and Accuracy/Time as Functions of Level of Complexity of the Second Type. Data are from Study 3.

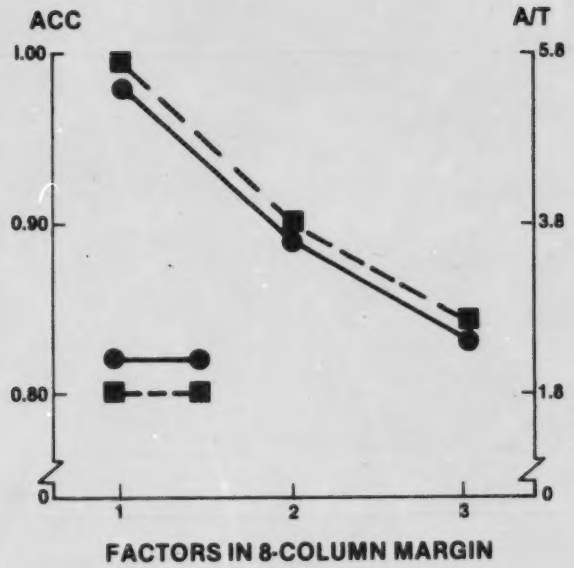

Figure 3. Accuracy and Accuracy/Time as Functions of Level of Complexity of the First Type. Tables are 10-row, 80-entry. Data are from Table 4.

4.44 Grade Level. The data from Studies 1, 2, and 3 and Probes 1A, 1B, 2A, 2B, 3A, and 3B cross Grades 4, 5, and 6. Excluding one-fourth of the Study 1 data, all of these investigations feature table-using performance. Although difficulty of the levied work varied from investigation to investigation based on extent of directions, task and mode, and perhaps tabular extensiveness, most of the featured tables were of low complexity. Four tables used in Study 3 were more complex.

Based on an intuitive classification for complexity, grade level means by level of complexity for the accuracy and accuracy/time measures are presented in Table 6.

Most investigations feature the simple retrieval (R11) task. When superlative (R12) and comparative (R13) retrieval tasks are levied, as in Probes 2B and 3A, performance declines--particularly for the accuracy/time measure. When the data from these probes are removed from the tabulation for simpler tables, the average accuracy gain is .01; the average accuracy/time gain is .4, with means rising to 4.0 for 4th grade, 4.7 for 5th grade, and 5.3 for 6th grade.

The Table 6 grade level means for simpler and more complex tables are graphed in Figure 4. Students at all grade levels perform quite accurately when retrieving information from the simpler tables. When the tables are more complex, accuracy improves with grade level, but is 6 to 15 points poorer than when simpler tables are processed.

However complex the table, accuracy/time performance improves with grade level. The performance of 4th graders in relation to that of 6th graders is better when the table is simpler than when it is more complex. Whereas 4th graders provide three-fourths as many correct responses per minute as 6th

Table 6
Accuracy and Accuracy/Time Means, by Grade Level, Studies and Probes Crossing Grades 4, 5, and 6

Complexity (Intuitive)	Study	Entries/ Complexity Code	Cell n	Task/Mode	Accuracy			Accuracy/Time		
					4th	5th	6th	4th	5th	6th
Simpler Table	1	8/1100	32	R11/M1	.99	.97	.95	4.8	4.7	6.2
	1A	36/1111	12	R11/M3	.93	1.00	.92	3.4	4.4	4.1
	1B	36/1111	12	R11/M2	.95	.99	.92	4.9	5.4	6.5
	2	24/1111	24	R11/M1	.94	.95	.91	3.9	4.9	5.4
	2A	49/1111 144/1111	12	R11/M1	.93	.92	.89	3.9	5.7	5.2
	2B	49/1111	12	R12/M3 R13/M3	.89	.93	.89	2.4	2.8	2.9
	3	81/1111 81/1211 81/1112	30	R11/M1	.92	.96	.97	4.2	4.7	5.1
	3A	81/1111	40	R11/M3 R12/M3 R13/M3	.89	.86	.94	2.5	3.0	3.5
	3B	81/1111	30	R11/M1	.85	.89	.92	3.2	4.1	4.7
	Cell n-Weighted Mean		204		.92	.93	.93	3.6	4.3	4.8
More Complex Table	3	81/1212 81/1311 81/1113 81/1313	40	R11/M1	.78	.82	.87	2.1	2.7	3.9

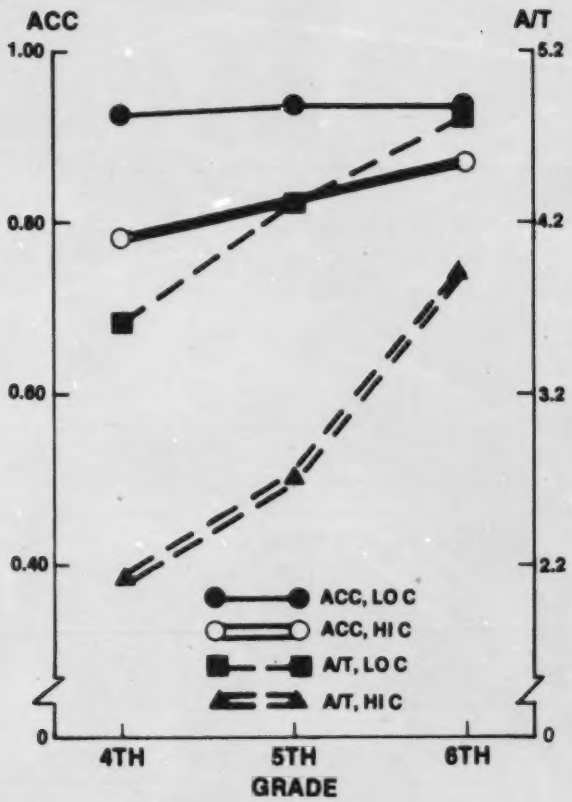

Figure 4. Accuracy and Accuracy/Time as Functions of Grade Level. Data are from Table 6.

graders when processing simpler tables, they manage just better than half as many correct responses per minute as 6th graders when processing more complex tables.

Although the data are not presented in Table 4, 3rd graders also participated in Study 1. When modestly directed, these students averaged .81 accuracy and 4.4 correct responses per minute when retrieving information from 8-entry tables. The 3rd graders tended to fall into two categories--those who performed quite accurately and those who hovered around change performance. As one might expect in light of the scarcity of tabular displays in published educational materials, the 3rd graders performed more accurately (.96) although more slowly (3.9 correct responses per minute) when the same information was presented in a short paragraph.

4.45 Practice Effects. The probe data relative to the study data reflect one type of practice effect. A more straightforward sort of evidence stems from Studies 1, 2, 3, 4, 7, and 8, wherein students responded successively to two blocks of 10 queries under identical conditions save for amount of prior practice. The pertinent data are presented in Table 7.

The practice antedating negotiation of the second block of 10 queries is unaccompanied by feedback concerning the suitability of performance. The Table 7 data indicate that accuracy does not improve during second-block performance, but accuracy/time performance improves appreciably in all studies. That is, the speed of responding improves appreciably as a function of uncritiqued practice.

4.46 Task-Clarifying Directions. Study 6 provides a basis for comparing the relative effects of scant and modest directions when the processed table is simple (81/1111) and when it is complex (81/1313). The pertinent data are presented in Table 8.

Table 7
Accuracy and Accuracy/Time Means, by Level of Practice

Study	Entries/ Complexity Code	Task/Mode	Cell n	Query Block	Accuracy				Accuracy/Time			
					4th	5th	6th	$\bar{X}$	4th	5th	6th	$\bar{X}$
1	8/1100	R11/M1	24	1	.99	.95	.93	.96	4.3	3.1	4.2	3.9
				2	1.00	1.00	.96	.98	5.7	6.3	8.2	6.7
2	24/1111	R11/M1	24	1	.95	.95	.90	.93	3.2	3.6	4.1	3.6
				2	.95	.95	.92	.94	4.7	6.3	6.7	5.9
3	81/1111 to 81/1313	R11/M1	70	1	.84	.90	.92	.89	2.8	3.4	3.7	3.3
				2	.84	.87	.91	.87	3.2	3.8	4.8	3.9
4	80/1111 to 80/1131	R11/M1	40	1	--	.82	.87	.84	--	2.6	3.4	3.0
				2	--	.83	.88	.85	--	3.7	4.7	4.2
7	81/1313	R11/M1	16	1	.58	--	.78	.68	1.0	--	1.8	1.4
				2	.46	--	.84	.65	1.5	--	2.6	2.0
8	81/1313	R11/M3 R2/M3		1	.46	--	.62	.54	.8	--	1.1	.9
				2	.46	--	.63	.54	1.1	--	1.7	1.4

Table 8
Accuracy and Accuracy/Time Means, by Level of Task-Clarifying Directions (Study 6)

Entries/ Complexity Code	Task/Mode	Cell n	Level of Directions	Accuracy			Accuracy/Time		
				4th	5th	$\bar{X}$	4th	5th	$\bar{X}$
81/1111	4 M3 tasks	32	Scant	.71	.75	.73	2.9	2.8	2.8
		32	Modest	.79	.81	.80	3.4	3.7	3.5
81/1313	4 M3 tasks	32	Scant	.32	.45	.39	1.1	1.5	1.3
		32	Modest	.34	.46	.40	1.2	1.6	1.4

Table 9
Accuracy and Accuracy/Time Means, by Response Mode

Probe	Entries/ Complexity Code	Cell n	Task/Mode	Accuracy				Accuracy/Time			
				4th	5th	6th	$\bar{X}$	4th	5th	6th	$\bar{X}$
2A	49/1111	6	R11/M1	.90	1.00	1.00	.97	4.5	7.4	6.2	6.0
1B	36/1111	12	R11/M2	.95	.99	.92	.95	4.9	5.4	6.5	5.6
1A	36/1111	12	R11/M3	.93	1.00	.92	.95	3.4	4.4	4.1	3.9

When the table is simple, modest directions yield better performance than scant directions. However, when the table is complex, participants perform about equally well (or poorly) whether scantly or modestly instructed.

The Study 6 directions were typewritten and too much copy was placed on a page, resulting in a cluttered appearance. Moreover, students were required to respond to four different types of task-levying queries, necessitating three changes in task set during the course of responding to 20 queries. Although the tables used were structurally identical to the least and the most complex featured in Study 3, the forementioned complicating factors in Study 6 resulted in much poorer performance than for comparable portions of Study 3.

4.47 Response Mode. The data base provides a meager basis for response mode comparisons. Three pertinent probes are 2A (49/1111, R11/M1), 1B (36/1111, R11/M2), and 1A (36/1111, R11/M3). Apt data from these probes are presented in Table 9.

M1 is the circle mode. In this mode, an appropriate entry is circled in the table. M2 is the fill-in mode. In it, the respondent retrieves an appropriate entry from the table and writes it in the blank of a fill-in query. M3 is the selected-response mode. In it, the respondent retrieves an appropriate entry from the table, finds its match among five alternatives presented below the query, and circles the correct alternative. It is evident from Table 9 that accuracy is impervious to response mode. However, accuracy/time progressively declines as one goes from M1 to M3. Performance in the M3 mode is appreciably slower than it is in either of the other two modes.

4.48 Number of Tasks/20 Queries. Again, the data base provides a meager basis for comparisons. Studies 6 and 8, involving 1 and 3 changes in task set, respectively, and Study 7, involving none, provide a basis for evaluating the task set changing factor. The appropriate data are presented in Table 10.

Based on the meager data base available, both accuracy and accuracy/time means decline when it becomes necessary to change task set during the course of responding to 20 queries.

Table 10
Accuracy and Accuracy/Time Means, by Number of Tasks per 20 Queries

Study	Entries/ Complexity Code	Cell n	Number of Tasks	Accuracy			Accuracy/Time		
				4th	6th	$\bar{X}$	4th	6th	$\bar{X}$
7	81/1313	16	1	.52	.81	.66	1.2	2.2	1.7
8	81/1313	16	2	.36	.49	.42	1.0	1.5	1.2
6	81/1313	64	4						

5. DISCUSSION

Following perfunctory clarification of the retrieval task, upper elementary schoolers are able to retrieve information accurately and quickly from noncomplex tables at all levels of tabular extensiveness studied (cf the simpler table portion of Table 6).

Performance falls off with increasing complication of the tabular display (cf Figures 2 and 3) and of conditions on performance (e.g., multiple tasks necessitating frequent shifts in task set; cf Table 10). But a basis exists in reported findings (Study 5, Table 4) for the view that a small investment in formal table-using instruction will insure reasonably accurate performance even when tables vary in complexity and associated performance conditions necessitate doing multiple tasks with frequent changes in task set. Moreover, the effects of uncritiqued practice on response speed, as reflected in the accuracy/time measure (Table 7), encourages the view that, when performance is reasonably accurate, practice alone in time will result in acceptably speeded table-using responses.

Modest instruction in table-using, accompanied by rather frequent practice opportunities, is all that is required to render most upper elementary schoolers proficient when processing the range of tabular displays pertinent to schooling objectives at 4th through 6th grade levels.

Of methodological interest, a researcher can minimize the cell n empirical investment by using a short screening device that identifies and excuses a small percentage of the population having serious difficulty with reading decoding tasks. The methodological problem for data analysis

posed by pronounced ceiling effects when the display and associated performance conditions are well within the competence of many participants in the research can be ameliorated or circumvented through reliance on the accuracy/time measure, which is insensitive to ceiling effects on accuracy. When accuracy means are high, the accuracy/time measure is more sensitive to treatment differences and so is the better parameter-evaluating vehicle. Where a complexity factor is at issue, the normality and homogeneity of variance conditions underlying use of the analysis of variance often are defeated by the data for the low-complexity cells of a design. In this light, it is encouraging (cf Figures 2 and 3) that forms of the accuracy and accuracy/time functions of complexity are so similar. The accuracy data in such cases typically fails to meet the conditions for normality and homogeneity of variance. The accuracy/time data either meet these conditions or can be made to do so through application of a square-root or similar transformation of the data.

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APPENDIX A

REPRESENTATIVE MATERIALS

Representative materials used in the research are described and their locus in the appendix is indicated in Table A-1.

Table A-1. Index of Representative Materials

Type	Table	Description	Page
DIRECTIONS	A-2	Study 1: Scant Task-Clarifying Directions	52
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	A-25	Study 4: Motor Vehicles (10x8, 1111)	75
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Type	Table	Description	Page
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	A-35	Probe 7-8A: Two Tables (Vertical Scan)	85

Table A-2
Study 1: Scant Task-Clarifying Directions

We wish to know how well students at your grade level can answer questions using tables. On each page there is a table at the top and two questions below. You are to find the answer to the question in the table and circle the answer. The answer will be a number or a word.

Imagine a table showing the names of 10 students and their scores on a spelling test to the right. In one line of this table might appear:

Don Wilson 74

If the question asks "What is Don Wilson's spelling score?" you circle 74. If the question asks "Which student's spelling score is 74?" you circle Don Wilson. That is the sort of thing you will be doing for the next several minutes.

Table A-3
Study 1: Modest Task-Clarifying Directions (2-Unit Table)

Here are some examples of what you will be doing. Answers to the first two problems are shown. Use the table to find the answer to the last two questions and circle the answer. Then raise your hand.

Number of Perfect Spelling Scores for Each 100 Students
(In 8 Schools in 1977)

School	Number of perfect scores for each 100 students	School	Number of perfect scores for each 100 students
(Adams)	3	Robbins	2
Carson	17	Turner	11
Forest	4	Valley	5
Powell	(13)	Wilson	9

X1 There were 13 perfect spelling scores for every 100 students at Powell School. This number is circled in the table.

X2 Adams School had 3 perfect spelling scores for every 100 students. This school is circled in the table.

X3 Which school had 9 perfect spelling scores for each 100 students? Find the answer in the table and circle it.

X4 How many perfect spelling scores were there for each 100 students at Carson School? Find the answer in the table and circle it.

Table A-4
Study 6: Scant Task-Clarifying Directions

A numerical table consists of four parts. First, there is a title above the table. The title tells what the table is about. At the left is the row margin and at the top is the column margin. The rest of the table--called the body--consists of numerical entries. Look at the table to identify the title, the row margin, the column margin, and the body.

Thousands of Tons of Different Crops Grown in Different Years.
(In the Land of Oz)

Crops	Year			
	1969	1970	1971	1972
Barley	23	43	68	57
Carrots	52	96	88	40
Grugoo	7	11	9	8
Peas	26	33	48	62
Wheat	49	83	93	99

If you want to know how much grugoo was grown in the Land of Oz in 1971, you move to the right along the grugoo row until you reach the 1971 column. The answer is 9. But 9 what? The title tells you that it is 9 thousand tons. So 9 thousand tons of grugoo were grown in the Land of Oz in 1971.

This particular table does not tell us how many people were living in the Land of Oz in 1971. There is such a table, and I looked at it. From it, I figure that 9 thousand tons of grugoo is enough to provide every child in Oz with one large bowl of grugoo every day. Whether the children of Oz want that much grugoo is unknown.

Table A-5
Study 6: Modest-Task-Clarifying Directions (Complex Table)

If you know how, it is easy to obtain information from a numerical table. Before continuing, take a quick look at the table.

Millions of Board Feet of Different Kinds of Lumber.
(Produced in sawmills of the Enchanted Forest in 1976)

Sawmill	Softwoods			Hardwoods			Total Softwoods and Hardwoods
	Pine	Red-wood	Total Soft-woods	Maple	Oak	Total Hard-woods	
New Town Mill 1	17	2	19	6	16	22	41
New Town Mill 2	38	5	43	26	12	38	81
NEW TOWN MILLS (NTM 1 + NTM 2)	55	7	62	32	28	60	122
Old Town Mill 1	43	1	44	9	3	12	56
Old Town Mill 2	80	8	88	18	11	29	117
OLD TOWN MILLS (OTM 1 + OTM 2)	123	9	132	27	14	41	173
ENCHANTED FOREST (NT Mills + OT Mills)	178	16	194	59	42	101	295

The table shows that more lumber was made from softwood than was made from hardwood in the Enchanted Forest in 1976. It also shows that the Old Town Mills made more lumber than the New Town Mills. Below, some questions are asked that can be answered using the table. The first four questions are answered (by circling one of the choices below the question). After studying these questions to see how they are answered, you are to work the last four questions (on the next page).

1. The number 55 in the first column is the sum of the entry numbers _____.
   30 + 25 20 + 35 (17 + 38) 43 + 12 10 + 45

2. Which sawmill produced the most pine lumber?
   NT Mill 1 NT Mill 2 OT Mill 1 (OT Mill 2)

3. The New Town Mills produced _____ million board feet of lumber from hardwood trees.
   101 62 122 (60) 28

4. CAREFUL NOW. The Old Town Mills produced less lumber from _____ trees than they did from oak trees.
   pine (redwood) softwood maple hardwood

Table A-6
Study 1: Conventional Table (8x1)

The Number of Cows for Each 100 People

(In 8 states in 1970)

State	Number of cows for each 100 people
Colorado	149
Idaho	239
Kansas	268
Nebraska	427
North Dakota	334
Oklahoma	195
South Dakota	662
Texas	109

A1 Which state had 334 cows for each 100 people?

Find the answer in the table and circle it.

A2 How many cows for each 100 people did Idaho have?

Find the answer in the table and circle it.

Table A-7
Study 1: Two-Unit Table

The Number of Cows for Each 100 People

(In 8 states in 1970)

State	Number of cows for each 100 people	State	Number of cows for each 100 people
Colorado	149	North Dakota	334
Idaho	239	Oklahoma	195
Kansas	268	South Dakota	662
Nebraska	427	Texas	109

A1 Which state had 334 cows for each 100 people?

Find the answer in the table and circle it.

A2 How many cows for each 100 people did Idaho have?

Find the answer in the table and circle it.

Table A-8
Study 1: Four-Unit Table

The Number of Cows for Each 100 People

(In 8 states in 1970)

State	Number of cows for each 100 people	State	Number of cows for each 100 people	State	Number of cows for each 100 people	State	Number of cows for each 100 people
Colorado	149	Kansas	268	North Dakota	334	South Dakota	662
Idaho	239	Nebraska	427	Oklahoma	195	Texas	109

A1 Which state had 334 cows for each 100 people?

Find the answer in the table and circle it.

A2 How many cows for each 100 people did Idaho have?

Find the answer in the table and circle it.

Table A-9
Study 1: Paragraph Format

Written below is the number of cows counted in 1970 for each 100 people in eight states. Colorado had 149 cows for each 100 people. Idaho had 239 cows. Kansas had 268. Nebraska had 427. North Dakota had 334. Oklahoma had 195. South Dakota had 662. Texas had 109 cows for each 100 people.

A1 Which state had 334 cows for each 100 people?
Find the answer in the paragraph and circle it.

A2 How many cows for each 100 people did Idaho have?
Find the answer in the paragraph and circle it.

Table A-10
Probe 1B: Fish Caught (Whole Number Entries)

Tons of Fish Caught by the Crews of Six Fishing Boats from 1971 to 1976.

Boat	1971	1972	1973	1974	1975	1976
Amanda	121	163	118	127	142	156
Buna-Lae	94	113	87	116	122	125
Francisco	209	188	219	215	236	224
Penguin	143	151	102	134	145	138
South Sea	304	306	293	321	308	295
Visayan	131	149	137	144	135	128

Use the table to find the answer to each question. Write the answer in the blank.

G1 The crew of the Buna-Lae caught _____ tons of fish in 1974.

G2 The crew of the Penguin caught _____ tons of fish in 1972.

G3 The crew of the Francisco caught _____ tons of fish in 1975.

G4 The crew of the Visayan caught _____ tons of fish in 1971.

G5 The crew of the Amanda caught _____ tons of fish in 1973.

G6 The crew of the Penguin caught _____ tons of fish in 1975.

G7 The crew of the Buna-Lae caught _____ tons of fish in 1973.

G8 The crew of the Visayan caught _____ tons of fish in 1974.

G9 The crew of the South Sea caught _____ tons of fish in 1972.

G10 The crew of the Francisco caught _____ tons of fish in 1973.

Table A-11
Probe 1B: Crabs Caught (Decimal Number Entries)

Tons of Crab Caught by the Crews of Six Fishing Boats from 1971 to 1976.

Boat	1971	1972	1973	1974	1975	1976
Amanda	12.1	16.3	11.8	12.7	14.2	15.6
Buna-Lae	9.4	11.3	8.7	11.6	12.2	12.5
Francisco	20.9	18.8	21.9	21.5	23.6	22.4
Penguin	14.3	15.1	10.2	13.4	14.5	13.8
South Sea	30.4	30.6	29.3	32.1	30.8	29.5
Visayan	13.1	14.9	13.7	14.4	13.5	12.8

Use the table to find the answer to each question. Write the answer in the blank.

G1 The crew of the Buna-Lae caught _____ tons of crab in 1974.

G2 The crew of the Penguin caught _____ tons of crab in 1972.

G3 The crew of the Francisco caught _____ tons of crab in 1975.

G4 The crew of the Visayan caught _____ tons of crab in 1971.

G5 The crew of the Amanda caught _____ tons of crab in 1973.

G6 The crew of the Penguin caught _____ tons of crab in 1975.

G7 The crew of the Buna-Lae caught _____ tons of crab in 1973.

G8 The crew of the Visayan caught _____ tons of crab in 1974.

G9 The crew of the South Sea caught _____ tons of crab in 1972.

G10 The crew of the Francisco caught _____ tons of crab in 1973.

Table A-12
Study 2: Alpha Red Planet (12x2)

Population (Millions) and Area (Thousands of Square Miles).

(In 12 countries of the Alpha Red Planet in 1970)

Country	Population (Millions)	Area (1000s of square miles)
Aragon	124	2114
Calico	214	1486
Dandora	125	790
Elvira	108	684
Grenada	179	971
Indigo	168	1744
Loredo	241	814
Matalan	131	1359
Paladin	221	832
Ramona	386	1612
Saturna	152	935
Tabula	197	764

A1 What was the population of Saturna? Find the answer in the table and circle it.

A2 What was the area of Matalan? Find the answer in the table and circle it.

Table A-13
Study 2: Alpha Red Planet (6x4)

Population (Millions), Life Span (Years), Area (Thousands of Square Miles), and Grain Production (Millions of Metric Tons).

(In 6 countries of the Alpha Red Planet in 1970)

Country	Population (Millions)	Life Span (Yrs.)	Area (1000s of square miles)	Grain Grown (Millions of metric tons)
Aragon	124	309	2114	214
Calico	214	252	1486	186
Grenada	179	207	971	98
Loredo	241	196	814	104
Ramona	386	281	1612	159
Tabula	197	214	764	83

A21 What was the life span (average years lived) for people in Tabula? Find the answer in the table and circle it.

A22 What was the area of Aragon? Find the answer in the table and circle it.

Table A-14
Study 2: Alpha Red Planet (3x8)

Population (Millions), Years of School Completed by Adults, Life Span (Years), Number of People Older than 500 Years, Area (Thousands of Square Miles), Annual Rainfall (Inches), Average Temperature (Degrees F), and Grain Production (Millions of Metric Tons).

(In 3 countries of the Alpha Red Planet in 1970)

Country	Population (Millions)	Years of school completed	Life Span (Yrs.)	No. people older than 500 years	Area (1000s of square miles)	Annual rainfall (inches)	Average Temperature (Degrees F)	Grain grown (millions of metric tons)
Calico	214	33	252	423	1486	72	66	186
Loredo	241	24	196	84	814	46	71	104
Tabula	197	29	214	117	764	13	78	83

A41 What was the area of Loredo? Find the answer in the table and circle it.

A42 What was the annual rainfall in Tabula? Find the answer in the table and circle it.

Table A-15
Probe 2A: Seven Towns (7x7)

Number of Dictionaries Sold Yearly in 7 Towns. (Every 5th year from 1945 to 1975)

Town	1945	1950	1955	1960	1965	1970	1975
Aurora	90	80	106	82	124	116	122
Danville	86	105	94	84	70	110	132
Hoopla	66	114	96	98	119	141	103
Main Branch	60	97	102	91	172	120	167
Prairie Dog	83	72	115	74	144	107	140
Saralee	88	100	113	87	128	165	142
Waverly	79	99	137	89	133	117	108

H1 How many dictionaries were sold in Danville in 1950? Find the answer in the table and circle it.

H2 How many dictionaries were sold in Prairie Dog in 1955? Find and circle the answer.

H3 How many dictionaries were sold in Hoopla in 1965? Find the circle the answer.

H4 How many dictionaries were sold in Saralee in 1960? Find and circle the answer.

H5 How many dictionaries were sold in Main Branch in 1970? Find and circle the answer.

Table A-16
Probe 2A: Twelve Towns (12x12)

Number of Dictionaries Sold Yearly in 12 Towns. (Every 5th year from 1920 to 1975)

Town	1920	1925	1930	1935	1940	1945	1950	1955	1960	1965	1970	1975
Aurora	16	30	6	2	43	90	80	106	82	124	116	122
Bobtown	12	29	3	41	61	51	65	69	53	109	59	64
Danville	34	32	20	36	52	86	105	94	84	70	110	132
Gold Hill	27	44	23	47	48	77	92	111	85	130	126	123
Hoopla	19	28	11	50	70	66	114	96	98	119	141	103
Lone Star	9	33	4	37	54	81	78	104	73	125	101	162
Main Branch	25	31	7	49	62	60	97	102	91	172	120	167
Oh Suzanna	18	26	8	45	68	76	121	134	90	131	112	136
Prairie Dog	21	39	13	38	55	83	72	115	74	144	107	140
Rodeo	15	22	5	1	67	58	75	93	95	118	158	127
Saralee	24	42	14	40	63	88	100	113	87	128	165	142
Waverly	17	35	10	46	57	79	99	137	89	133	117	108

H1 How many dictionaries were sold in Danville in 1950? Find the answer in the table and circle it.

H2 How many dictionaries were sold in Prairie Dog in 1940? Find and circle the answer.

H3 How many dictionaries were sold in Gold Hill in 1965? Find and circle the answer.

H4 How many dictionaries were sold in Saralee in 1930? Find and circle the answer.

H5 How many dictionaries were sold in Bobtown in 1935? Find and circle the answer.

Table A-17
Study 3: Crops Grown (9x9, 1111)

Millions of Pounds of Different Crops Grown.
(In counties of the Gypsum Republic in 1976)

County	Barley	Beans	Carrots	Corn	Peas	Tomatoes	Turnips	Wheat	Yams
Albert	7	37	63	28	51	77	27	36	41
Carson	25	12	52	126	17	53	1	76	75
Fremont	5	29	66	67	40	68	23	19	45
Harper	10	15	54	233	21	59	11	43	48
Morgan	8	26	62	78	47	71	24	30	42
Parish	22	2	50	84	32	57	4	38	55
Stuart	6	28	64	69	39	65	16	31	44
Taylor	14	18	49	164	34	58	3	35	62
Watson	9	20	56	70	38	60	13	33	46

Find the answer in the table and circle it.

A11 How many million pounds of corn were grown in Harper County?

A12 How many million pounds of carrots were grown in Fremont County?

A13 How many million pounds of beans were grown in Carson County?

A14 How many million pounds of wheat were grown in Parish County?

A15 How many million pounds of turnips were grown in Fremont County?

Table A-18
Study 3: Crops Grown (9x9, 1211)

Millions of Pounds of Different Crops Grown.
(In counties of the Gypsum Republic in 1976)

County	Barley	Beans	Carrotts	Corn	Peas	Tomatoes	Turnips	Wheat	Yams
Albert	7	37	63	28	51	77	27	36	41
Carson	25	12	52	126	17	53	1	76	75
Fremont	5	29	66	67	40	68	23	19	45
Harper	10	15	54	233	21	59	11	43	48
Morgan	8	26	62	78	47	71	24	30	42
Parish	22	2	50	84	32	57	4	38	55
Stuart	6	28	64	69	39	65	16	31	44
Taylor	14	18	49	164	34	58	3	35	62
Total for Gypsum Republic	97	167	460	849	281	508	109	308	412

Find the answer in the table and circle it.

A21 How many million pounds of corn were grown in Harper County?

A22 How many million pounds of carrots were grown in Fremont County?

A23 How many million pounds of beans were grown in Gypsum Republic?

A24 How many million pounds of wheat were grown in Parish County?

A25 How many million pounds of turnips were grown in Gypsum Republic?

Table A-19
Study 3: Crops Grown (9x9, 1212)

Millions of Pounds of Different Crops Grown.
(In counties of the Gypsum Republic in 1976)

County	Barley	Carrots	Corn	Peas	Tomatoes	Turnips	Wheat	Yams	Total for all Crops
Albert	7	63	28	51	77	27	36	41	330
Carson	25	52	126	17	53	1	76	75	425
Fremont	5	66	67	40	68	23	19	45	333
Harper	10	54	233	21	59	11	43	48	479
Morgan	8	62	78	47	71	24	30	42	362
Parish	22	50	84	32	57	4	38	55	342
Stuart	6	64	69	39	65	16	31	44	334
Taylor	14	49	164	34	58	3	35	62	419
Total for Gypsum Republic	97	460	849	281	508	109	308	412	3,024

Find the answer in the table and circle it.

A41 How many million pounds of corn were grown in Harper County?

A42 How many million pounds of carrots were grown in Fremont County?

A43 How many million pounds of all crops were grown in Carson County?

A44 How many million pounds of wheat were grown in Parish County?

A45 How many million pounds of turnips were grown in the Gypsum Republic?

Table A-20
Study 3: Crops Grown (9x9, 1311)

Thousands of Tons of Different Crops Grown.
(In counties of the Gypsum Republic in 1976)

County	Barley	Beans	Carrots	Corn	Pees	Tomatoes	Turnips	Wheat	Yams
Albert	7	37	63	28	51	77	27	36	41
Fremont	5	29	66	67	40	68	23	19	45
Morgan	8	26	62	78	47	71	24	30	42
Total for Northern Counties	20	92	191	173	138	216	74	85	128
Carson	25	12	52	126	17	53	1	76	75
Harper	10	15	54	233	21	59	11	43	48
Parish	22	2	50	84	32	57	4	38	55
Total for Southern Counties	57	29	156	443	70	169	16	157	178
Total for Gypsum Republic	77	121	347	616	208	285	90	242	306

Find the answer in the table and circle it.

A51 How many thousands of tons of corn were grown in Harper County?

A52 How many thousands of tons of carrots were grown in Fremont County?

A53 How many thousands of tons of beans were grown in the Northern Counties of Gypsum Republic?

A54 How many thousands of tons of wheat were grown in Parish County?

A55 How many thousand of tons of turnips were grown in the Southern Counties of Gypsum Republic?

Table A-21
Study 3: Crops Grown (9x9, 1313)

Thousands of Tons of Different Crops Grown.
(In counties of the Gypsum Republic in 1976)

County	Grain Crops				Root Crops				Total for all Crops
	Barley	Corn	Wheat	Total	Carrots	Turnips	Yams	Total	
Albert	7	28	36	71	63	27	41	131	202
Fremont	5	67	19	91	66	23	45	134	225
Morgan	8	78	30	116	62	24	42	128	244
Total for Northern Counties	20	173	85	278	191	74	128	393	671
Carson	25	126	76	227	52	1	75	128	355
Harper	10	233	43	286	54	11	48	113	399
Parish	22	84	38	144	50	4	55	109	253
Total for Southern Counties	57	443	157	657	156	16	178	350	1007
Total for Gypsum Republic	77	616	242	935	347	90	306	743	1678

Find the answer in the table and circle it.

A71 How many thousand tons of corn were grown in Harper County?

A72 How many thousand tons of carrots were grown in Fremont County?

A73 How many thousand tons of grain crops were grown in the Northern Counties of the Gypsum Republic?

A74 How many thousand tons of wheat were grown in Parish County?

A75 How many thousand tons of all crops were grown in the Southern Counties of Gypsum Republic?

Table A-22
Probe 3B: Fertilizer (X Row Factor)

Pounds of Fertilizer Used and Hundred-Weights (Hundreds of Pounds) of Vegetables Grown on Each Acre. (In the Gypsum Republic In 1975)

Pounds of fertilizer used on each acre	Hundred-weights of vegetables grown on each acre								
	Beans	Carrots	Corn	Lettuce	Onions	Peas	Squash	Turnips	Yams
0	23	41	18	37	44	14	39	47	51
100	76	94	31	62	83	36	55	74	88
200	98	146	75	101	126	77	103	106	135
300	107	180	90	174	149	93	127	142	178
400	104	181	98	195	166	92	139	164	194
500	102	173	100	210	157	89	143	160	193
600	99	165	95	192	145	80	141	155	190
700	91	151	82	185	132	68	138	152	186
800	76	124	70	168	114	61	136	148	182

Find the answer in the table and circle it.

A11 When farmers used 500 pounds of fertilizer, how many hundred-weights of corn were grown?

A12 When farmers used 300 pounds of fertilizer, how many hundred-weights of squash were grown?

A13 When farmers used 700 pounds of fertilizer, how many hundred-weights of onions were grown?

A14 When farmers used 100 pounds of fertilizer, how many hundred-weights of turnips were grown?

A15 When farmers used 400 pounds of fertilizer, how many hundred-weights of carrots were grown?

Table A-23
Probe 3B: Vegetables (U Row Factor)

Hundred-Weights (Hundreds of Pounds) of Vegetables
Grown on Each Acre.
(In counties of the Gypsum Republic in 1975)

County	Hundred-weights of vegetables grown on each acre								
	Beans	Carrots	Corn	Lettuce	Onions	Peas	Squash	Turnips	Yams
Albert	86	169	92	178	182	85	148	153	184
Carson	104	157	84	198	168	94	144	150	188
Fremont	118	172	96	174	171	91	135	154	185
Harper	99	175	89	180	162	79	139	164	183
Morgan	100	181	98	195	161	93	158	177	206
Parish	127	186	102	209	179	101	147	165	173
Stuart	114	182	95	214	155	83	142	170	191
Taylor	106	166	97	192	163	103	138	176	167
Watson	90	193	108	211	156	105	126	160	194

Find the answer in the table and circle it.

A21 In Parish County, how many hundred-weights of corn were grown?

A22 In Harper County, how many hundred-weights of squash were grown?

A23 In Taylor County, how many hundred-weights of onions were grown?

A24 In Carson County, how many hundred-weights of turnips were grown?

A25 In Morgan County, how many hundred-weights of carrots were grown?

Table A-24
Probe 3B: Vegetables (T Row Factor)

Hundred-Weights (Hundreds of Pounds) of Vegetables
Grown on Each Acre.
(In the Gypsum Republic from 1935 to 1975

Year	Hundred-weights of vegetables grown on each acre								
	Beans	Carrots	Corn	Lettuce	Onions	Peas	Squash	Turnips	Yams
1935	98	143	46	87	121	38	106	124	133
1940	97	150	54	109	118	41	127	128	145
1945	99	161	75	123	140	50	134	137	156
1950	94	170	80	142	159	66	148	149	173
1955	101	168	85	165	163	78	147	158	180
1960	103	171	84	178	164	82	139	162	179
1965	102	174	90	187	169	91	146	172	190
1970	107	177	96	198	167	93	144	157	193
1975	104	175	95	192	166	92	141	160	188

Find the answer in the table and circle it.

A31 In 1960, how many hundred-weights of corn were grown?

A32 In 1950, how many hundred-weights of squash were grown?

A33 In 1970, how many hundred-weights of onions were grown?

A34 In 1940, how many hundred-weights of turnips were grown?

A35 In 1955, how many hundred-weights of carrots were grown?

Table A-25
Study 4: Motor Vehicles (10x8, 1111)

Thousands of Motor Vehicles Owned.
(By people in counties of the Gypsum Republic
from 1940 to 1975)

County	1940	1945	1950	1955	1960	1965	1970	1975
Albert	29	27	33	39	46	50	56	61
Carson	128	133	174	225	301	414	469	513
Fremont	60	58	64	73	82	89	105	125
Harper	28	26	31	32	36	40	48	59
Morgan	101	97	127	145	168	184	198	210
Parish	106	114	142	181	207	312	401	452
Stuart	123	119	151	194	243	336	431	481
Taylor	44	41	47	51	55	63	74	90
Watson	81	83	99	108	134	160	173	195
Zeeman	84	88	111	129	155	186	231	258

Find the answer in the table and circle it.

C11 How many thousand motor vehicles were owned by people in Fremont County in 1965?

C12 How many thousand motor vehicles were owned by people in Watson County in 1950?

C13 How many thousand motor vehicles were owned by people in Parish County in 1970?

C14 How many thousand motor vehicles were owned by people in Harper County in 1955?

C15 How many thousand motor vehicles were owned by people in Taylor County in 1945?

Table A-26
Study 4: Cars and Trucks (10x8, 1121)

Thousands of Cars and Trucks Owned.
(By people in counties of the Gypsum Republic from 1960 to 1975)

County	1960		1965		1970		1975	
	Cars	Trucks	Cars	Trucks	Cars	Trucks	Cars	Trucks
Albert	41	5	31	19	34	22	37	24
Carson	242	59	373	41	418	51	459	54
Fremont	42	40	57	32	60	45	75	50
Harper	23	13	25	15	27	21	30	29
Morgan	110	58	129	55	128	70	147	63
Parish	193	14	279	33	365	36	405	47
Stuart	228	18	274	62	388	43	432	49
Taylor	38	17	37	26	46	28	53	39
Watson	73	61	112	48	117	56	129	56
Zeeman	139	16	151	35	187	44	206	52

C21 How many thousand trucks were owned by people in Fremont County in 1970?

C22 How many thousand cars were owned by people in Watson County in 1965?

C23 How many thousand cars were owned by people in Parish County in 1960?

C24 How many thousand trucks were owned by people in Harper County in 1975?

C25 How many thousand cars were owned by people in Taylor County in 1965?

Table A-27
Study 4: Cars and Trucks, Men and Women (10x8, 1131)

Thousands of Cars and Trucks Owned by Men and Women.
(In Counties of the Gypsum Republic in 1970 and 1975.)

	1970				1975			
	Cars		Trucks		Cars		Trucks	
County	Owned by Men	Owned Women	Owned by Men	Owned Women	Owned by Men	Owned Women	Owned by Men	Owned Women
Albert	10	24	18	4	11	26	19	5
Carson	201	217	46	5	220	239	48	6
Fremont	19	41	36	9	23	52	40	10
Harper	7	20	13	8	9	21	17	12
Morgan	38	90	56	14	44	103	50	13
Parish	173	192	33	3	190	215	43	4
Stuart	201	187	42	1	214	218	47	2
Taylor	15	31	22	6	16	37	32	7
Watson	35	82	45	11	39	90	51	15
Zaeman	88	99	42	2	101	105	49	3

Find the answer in the table and circle it.

C31 In 1970, how many thousand trucks were owned by men in Fremont County?

C32 In 1975, how many thousand cars were owned by women in Watson County?

C33 In 1970, how many thousand cars were owned by men in Parish County?

C34 In 1970, how many thousand trucks were owned by women in Harper County?

C35 In 1975, how many thousand trucks were owned by men in Taylor County?

Table A-28
Study 6: Kitchen Items (Comprehension, R2)

Millions of Kitchen Items Produced.
(In countries of the Beta Green Planet in 1976)

Country	Bowls	Cups	Dishes	Forks	Knives	Pans	Pots	Saucers	Spoons
Bastille	19	17	27	35	53	23	14	8	26
Doreen	43	63	50	45	93	52	12	68	81
Fabian	96	115	85	184	258	114	102	103	203
Garcia	214	287	306	336	460	268	315	324	424
Lorena	109	140	64	162	159	122	105	88	217
Marco	118	291	235	245	284	87	71	164	227
Pauline	33	48	21	57	62	15	9	13	40
Sophia	142	165	190	176	171	117	186	157	155
Tamura	83	182	126	204	229	49	37	172	218

Use the table to find the answer to each question. Then circle the answer below the question.

A1. One kind of kitchen item mentioned in the table is _____.

jars ladles ovens pans tongs

A2. The table shows _____ of kitchen items produced.

dozens hundreds thousands millions billions

A3. The countries mentioned in the table are located on the _____ Planet.

Alpha Red Beta Green Gamma Blue Kitchenware Baby Green

A4. The table mentions _____ kinds of kitchen items.

6 7 8 9 10

A5. One of the countries mentioned is _____.

Durango Longina Marco Slobovia Tampa

Table A-29
Study 6: Fruits (Simple Retrieval, R11)

Thousands of Tons of Different Fruits Grown.
(In countries of the Alpha Red Planet in 1976)

Country	Apples	Berries	Cherries	Grapes	Lemons	Melons	Oranges	Peaches	Pears
Aragon	77	7	37	63	27	36	41	28	51
Calico	53	25	12	52	1	76	75	126	17
Elvira	68	5	29	66	23	19	45	67	40
Grenada	59	10	15	54	11	43	48	233	21
Indigo	71	8	26	62	24	30	42	78	47
Loredo	57	22	2	50	4	38	55	84	32
Ramona	65	6	28	64	16	31	44	69	39
Saturna	58	14	18	49	3	35	62	164	34
Tabula	60	9	20	56	13	33	46	70	38

Use the table to find the answer to each question. Then circle the answer below the question.

A6. The farmers of Indigo grew _____ thousand tons of cherries in 1976.

10 15 54 26 62

A7. In 1976, the farmers of Elvira grew 66 thousand tons of _____.

berries cherries grapes melons pears

A8. The farmers of _____ grew 44 thousand tons of oranges in 1976.

Aragon Elvira Grenada Ramona Tabula

A9. In Loredo in 1976 the farmers grew _____ thousand tons of oranges.

57 50 38 42 55

A10. In 1976, 164 thousand tons of peaches were grown by the farmers of _____.

Calico Grenada Loredo Saturna Tabula

Table A-30
Study 6: Crops (Superlative Retrieval, R12)

Millions of Pounds of Different Crops Grown.
(in valleys of the Gypsum Republic in 1976)

Valley	Barley	Beans	Carrots	Corn	Peas	Tomatoes	Turnips	Wheat	Yams
Albert	7	37	63	28	51	77	27	36	41
Carson	25	12	52	126	17	53	1	76	75
Fremont	5	29	66	67	40	68	23	19	45
Harper	10	15	54	233	21	59	11	43	48
Morgan	8	26	62	78	47	71	24	30	42
Parish	22	2	50	84	32	57	4	38	55
Stuart	6	28	64	69	39	65	16	31	44
Taylor	14	18	49	164	34	58	3	35	62
Watson	9	20	56	70	38	60	13	33	46

Use the table to find the answer to each question. Then circle the answer below the question.

B1. Which valley grew the largest amount of beans in 1976?

Albert Fremont Morgan Stuart Watson

B2. Which crop did Taylor Valley grow the smallest amount of in 1976?

barley corn peas turnips wheat

B3. In 1976, which valley grew the smallest amount of tomatoes?

Albert Carson Harper Parish Taylor

B4. Which crop did Morgan Valley grow the largest amount of in 1976?

carrots corn peas tomatoes yams

B5. Which valley grew the largest amount of carrots in 1976?

Albert Carson Fremont Morgan Stuart

Table A-31
Study 6: Clothing (Comparative Retrieval, R13)

Millions of Different Articles of Clothing Produced.
(in countries of the Gamma Blue Planet in 1976)

Countries	Belts	Blouses	Coats	Hats	Pants	Shirts	Shoes	Socks	Vests
Barkle	60	58	65	57	71	59	68	53	77
Dorgan	9	14	6	22	8	10	5	25	7
Grax	20	18	28	2	26	15	29	12	37
Lothar	56	49	64	50	62	48	66	52	63
Morget	13	16	3	4	24	101	23	1	27
Prang	33	35	31	38	30	21	19	76	36
Rathis	46	62	44	55	42	54	45	75	41
Spock	70	69	98	84	78	11	67	93	28
Worpin	38	39	34	32	47	43	40	17	51

Use the table to find the answer to each question. Then circle the answer below the question.

B6. Which country produced fewer blouses than Morget did in 1976?

Barkle Dorgan Grax Prang Worpin

B7. What kind of clothing did Prang produce more of than hats in 1976?

blouses coats pants socks vests

B8. In 1976, which country produced more shoes than Spock did?

Barkle Lothar Morget Rathis Worpin

B9. In 1976, what kind of clothing did Rathis produce more of than blouses?

hats pants shirts socks vests

B10. Which country produced fewer shirts than Spock did in 1976?

Dorgan Grax Lothar Prang Worpin

Table A-32
Probe 7-8A: One Table (Horizontal Scan)

DIRECTIONS AND EXERCISE

In a minute, you are to work six addition problems given in the table below. You are to add the two numbers in the same row and write your answer in the blank space in the row's third column. The first problem is already worked. The answer is 19.

You may use any method you wish to work these problems--except looking at your neighbor's work. Begin.

Thousands of Tons of Grugoo grown.
(In the Land of Oz in 1969 and 1970)

Kingdom	1969	1970	Total for 1969 + 1970
Amanda	14	5	19
Cowardly Lion	7	15	
Dorothyville	23	6	
Emerald City	8	17	
Scarecrow	19	10	
Tin Woodman	9	13	
Yolanda	12	11	

Table A-33
Probe 7-8A: Two Tables (Horizontal Scan)

DIRECTIONS AND EXERCISE

In a minute, you are to work six addition problems by summing an entry in one table and an entry in a second table and placing your answer in a third table. The first two problems are already worked. For the first problem, 14 + 5 = 19. For the second problem, 3 + 18 = 21.

You may use any method you wish to work these problems--except looking at your neighbor's work.

Thousands of Tons of Grugoo and Blugoo Grown.
(in the Land of Oz in 1969 and 1970)

Grugoo Grown in 1969-1970

Kingdom	1969	1970
Amanda	14	3
Emerald City	7	19
Scarecrow	23	9
Tin Woodman	8	12

Blugoo Grown in 1969-1970

Kingdom	1969	1970
Amanda	5	18
Emerald City	15	8
Scarecrow	6	13
Tin Woodman	17	9

Grugoo + Blugoo Grown in 1969 and 1970

Kingdom	1969	1970
Amanda	19	21
Emerald City		
Scarecrow		
Tin Woodman		

Table A-34
Probe 7-8A: One Table (Vertical Scan)

DIRECTIONS AND EXERCISE

In a minute, you are to work six addition problems given in the table below. You are to add the two numbers in the same column and write your answer in the blank space in the column's third row. The first problem is already worked. The answer is 19.

You may use any method you wish to work these problems--except looking at your neighbor's work. Begin.

Thousands of Tons of Grugoo Grown.
(In the Land of Oz in 1969 and 1970)

Year	Kingdom						
	Amanda	Cowardly Lion	Dorothy-ville	Emerald City	Scare-crow	Tin Woodman	Yolanda
1969	14	7	23	8	19	9	12
1970	5	15	6	17	10	13	11
Total for 1969 + 1970	19						